

Sociobiological Perspectives on Human Development

Kevin B. MacDonald

Editor

Sociobiological Perspectives on Human Development

With 17 Figures



Springer-Verlag
New York Berlin Heidelberg
London Paris Tokyo

KEVIN B. MACDONALD
Department of Psychology
California State University
Long Beach, California 90840, USA

Library of Congress Cataloging-in-Publication Data
Sociobiological perspectives on human development.

Includes bibliographies and index.

1. Psychology. 2. Sociobiology. I. MacDonald,
Kevin. [DNLM: 1. Behavior. 2. Human Development.
3. Psychology. BF 713 S678]

BF121.S62 1988 155.7 87-28369

ISBN-13: 978-1-4612-8338-6 e-ISBN-13: 978-1-4612-3760-0

DOI: 10.1007/978-1-4612-3760-0

© 1988 by Springer-Verlag New York Inc.

Softcover reprint of the hardcover 1st edition 1988

All rights reserved. This work may not be translated or copied in whole or in part without the written permission of the publisher (Springer-Verlag, 175 Fifth Avenue, New York, NY 10010, USA), except for brief excerpts in connection with reviews or scholarly analysis. Use in connection with any form of information storage and retrieval, electronic adaptation, computer software, or by similar or dissimilar methodology now known or hereafter developed is forbidden.

The use of general descriptive names, trade names, trademarks, etc. in this publication, even if the former are not especially identified, is not to be taken as a sign that such names, as understood by the Trade Marks and Merchandise Marks Act, may accordingly be used freely by anyone.

Typeset by Publishers Service, Bozeman, Montana.

9 8 7 6 5 4 3 2 1

Preface

Sociobiology is the study of behavior within the framework of contemporary evolutionary biology. As a synthesis of ideas from population genetics, ethology, and behavioral ecology, it has had a profound effect on the analysis of the behavior of animals. The acceptance of this body of theory as appropriate to the analysis of human behavior has come more slowly, but there is now a large body of literature concerning human behavior which is based on sociobiological theorizing. This work has resulted in an important reorientation in the field of anthropology, and recent work suggests an equally important potential impact on psychology. This volume centers on the application of sociobiological theorizing to the study of human development.

The studies collected here address a wide variety of old and new problems in developmental psychology which sociobiological theorizing and the data generated from this body of theory can illuminate. The field of human sociobiology is a growing and vital area, an area that has been greatly enriched both by recent theoretical advances as well as the collection of relevant data. It is a constantly changing field which is becoming more sophisticated both theoretically and methodologically. The early controversies surrounding sociobiology are largely irrelevant to current concerns, and as is the case with any good theory there is great variety among individuals who have been strongly influenced by it. That influence ranges from specific points of the theory to the interpretation of data and the problems that are thought to be important. This volume certainly reflects that diversity.

The first section of the book is devoted to theoretical issues arising from the interface between evolutionary thinking and developmental psychology. In the introductory chapter, I summarize the general approaches to developmental issues that have derived from sociobiological theory. The main point of the chapter is to describe the theoretical basis of human sociobiology and especially to emphasize the points of integration between established theoretical perspectives within developmental psychology and this new perspective. Particularly important is an attempt to deal with critical theoretical issues which have been

the focus of past criticisms of sociobiology, including the issues of reductionism and the adaptiveness of behavior. In addition, the areas within developmental psychology that will be most likely to be influenced by evolutionary theory are described.

Chapter 2 by William R. Charlesworth on resource allocation among children is a highly original attempt to view much of the behavior of children as organized around obtaining resources which satisfy ultimate biological imperatives such as maintenance, development, and reproduction. This thesis is the very essence of an evolutionary, behavioral ecological approach to human development, and Charlesworth develops this basic idea by categorizing resource dimensions, providing a framework for conceptualizing resource-directed behavior, and sketching the developmental implications of these ideas. The perspective provided by this effort is in the tradition of the broad categorization systems which have been very influential within developmental psychology, such as the ecological approach of Urie Bronfenbrenner and the contextualist approach of Richard Lerner, and I believe that it will prove to be a basic organizing principle for many of the central ideas of developmental psychology, including moral reasoning, prosocial behavior, aggression, cooperation, attachment, adolescent sexual behavior, psychopathology, and many others.

Chapter 3 by James S. Chisholm addresses a different set of theoretical issues relevant to the interface between evolutionary thinking and developmental psychology. Chisholm points to the relative lack of interest in the phenotype in traditional population genetics and emphasizes instead the relative indeterminacy of the relationship between genes and behavior, particularly for the more advanced vertebrates such as our own species. Especially prominent in his discussion are the ideas of developmental canalization and plasticity, and he provides examples of each phenomenon and relates them to life history theory derived from the biological field of behavioral ecology. Chisholm emphasizes the role of early experience not only in influencing the later phenotype, but also as influencing phylogeny by engendering novel selection pressures. The three chapters in this section thus reconcile areas of vital theoretical interest within developmental psychology with contemporary evolutionary theory.

The second section of the volume is concerned with some of the traditional topic areas of developmental psychology. This section illustrates well the ability of sociobiological theory to shed new light on traditional areas of developmental psychology as well as to present new testable hypotheses regarding human development. In Chapter 4, Dennis Krebs, Kathy Denton, and Nancy C. Higgins review a large body of research on self-knowledge and self-deception from a sociobiological perspective. The perspective taken here is a radical departure from the perspective of cognitive developmental theory which has been so influential in

developmental psychology. Rather than viewing the person as the rational, objective decision maker, these authors review a growing literature indicating that people often deceive themselves and have all sorts of biases in self-conception which function generally in an adaptive manner. The authors show the strong links between this literature and sociobiological theory, and pave the way for an increased emphasis on these areas within developmental research.

My chapter on sociobiology and the cognitive-developmental tradition in moral development further develops the ideas of the self-justificatory and self-deceptive aspects of moral reasoning and attempts to show that the literature in this area can be interpreted within a sociobiological framework. The cognitive-developmental tradition in moral development has assumed a central place in developmental research and theory, and the ability of sociobiological theory to incorporate this work must be viewed as an important triumph of contemporary evolutionary theory. Although this reinterpretation leads to the rejection of several key claims advanced by some cognitive-developmentalists, particularly the claim of a strong connection between moral reasoning and moral behavior, the overall result of this exercise is one of integration between two previously very disparate theoretical perspectives.

One of the key ideas of sociobiological theory illustrated throughout this volume is the importance of the degree of biological relatedness in biasing human behavior. This is nowhere better illustrated than in Nancy L. Segal's work on human twinships. In Chapter 6 Segal describes the "special intimacy" shared by identical twins and relates this to patterns of cooperation, competition, and altruism. Particularly striking is the increased affective investment the members of identical pairs of twins appear to have, as indicated by patterns of bereavement and their behavior after being reunited. Segal's chapter also illustrates how an established methodology such as that of behavioral genetics can be expanded as the result of new hypotheses and research designs resulting from sociobiological theory.

Glenn E. Weisfeld and Robin L. Billings, in Chapter 7, bring an evolutionary, adaptationist perspective to some of the central issues of adolescent development, including physical and sexual maturation, girls' puberty rites, intergenerational conflict, same-sex bonding, and sex differences in courtship, competitiveness, achievement, and nurturance. Particularly fascinating are their discussions of male dominance, physical attractiveness, and maturation rate. They describe data indicating the continuity of male dominance from childhood to adolescence and its dependence on highly heritable traits such as physical strength and athletic ability. Their chapter illustrates again the ability of sociobiological theory to integrate the findings from a large number of previous developmental studies done within a variety of theoretical perspectives, and thus illustrates the remarkable degree to which hypotheses directly

derived from evolutionary theory correctly predict observed patterns of behavior.

Chapter 8, by Charles J. Lumsden, illustrates again the integrative potential of evolutionary thinking. Lumsden organizes a large body of developmental research on cognition by emphasizing species-wide epigenetic rules of cognitive processing. Focusing on prohibitions on incest, color vision, language acquisition, and musical understanding, he illustrates epigenetic rules which act to constrain the development of the phenotype within a restricted range. It is clear from Lumsden's chapter, however, that although the epigenetic rules act to constrain development and culture so that some phenotypes are impossible, there is considerable plasticity in the system.

The final section of the volume is concerned with parent-child relationships, an area that promises to be a central focus of sociobiological influence in developmental psychology. The section begins with Chapter 9, by Martin S. Smith, who reviews work done on several key areas of parent-child interaction deriving from sociobiological theory. He describes data indicating that degree of genetic relatedness and the reproductive value of a child are important moderator variables in parent-child interactions. Moreover, his research on grandparents and inheritance illustrates well the power of sociobiological theory in generating new empirical predictions, many of which have been confirmed. Smith also reviews recent theory on kin selection mechanisms as well as data which suggest the importance of phenotypic matching and genetic similarity in kin recognition. This is an area of research that is just opening, and it is clear that we have only begun to realize the importance of these mechanisms for understanding human relationships.

In Chapter 10 Robert L. Burgess, Jeffrey A. Kurland, and Emily Pensky focus on the dark side of parent-child interaction, using sociobiological theory to illuminate some aspects of violence toward children. As others have done throughout the volume, they emphasize the compatibility of the various theoretical perspectives on these issues, and place the issues in a cross-cultural, historical, and cross-species context. Moreover, the chapter takes a highly contextualist perspective of child maltreatment, emphasizing biological and environmentally induced characteristics of the persons involved as well as the economic and social context of their behavior. Particularly interesting is their development of the idea of environmental instability and its effects on resources as a predisposing factor in child maltreatment. In Charlesworth's terms (Chapter 2), child abuse often occurs in an environment deficient in appropriate resources, including economic as well as affective resources. The authors demonstrate quite clearly that the evolutionary-ecological approach can integrate the massive social science literature on child abuse as well as generate new predictions. The chapter also deals very sensitively with the idea of the adaptiveness of behavior. Although well-reasoned adaptationist explanations abound

in the article, the idea of environmental instability and the emphasis on the balance between resources and stress are clearly compatible with the occurrence of maladaptive behavior. Their treatment shows, as they point out, that an evolutionary approach is not restricted to providing adaptationist explanations of behavior, but can shed light on maladaptive behavior as well.

In Chapter 11, I develop a multifaceted theory which attempts to account for historical and cross-cultural patterns of the socialization of children and the transmission of culture. The chapter thus draws extensively on anthropological, historical, and contemporary data on socialization while the theoretical basis of the chapter derives from social learning theory, ethology, and sociobiology. This endeavor is an example of the type of problem and type of integration which could not be addressed by the established theories of developmental psychology, and it illustrates again the broad, integrative ability of a sociobiological approach.

Chapter 12, by Patricia Draper and Henry Harpending, as well as Chapter 13, by Jenny Blain and Jerome Barkow, illustrate several emerging themes and areas of interest in developmental human sociobiology. First, the approach is cross-cultural. They describe data from a wide variety of societies and place human development in a much broader context than is typical within developmental psychology. Second, there is concern with the plasticity of behavior in response to ecological contingencies. They review research on the adaptiveness of learning as well as research indicating epigenetic rules which bias learning in particular ways. These concerns, which are typical of other chapters in this volume, do much to dispel the belief that human sociobiology is exclusively concerned with behaviors which are genetically determined. Third, the focus is not on cross-cultural universals of development but on attempting to explain cross-cultural variation within a sociobiological framework. Particularly important in this regard is their interest in the correlates of father absence. Their approach is to attempt to explain variation in reproductive behavior by proposing a learning mechanism by which individuals are influenced by the availability of resources in their environment. This hypothesis illustrates the salience of resources and economic production in evolutionary thinking, themes that are illustrated throughout the volume.

Overall, the volume argues that sociobiological theorizing must come to the forefront within developmental psychology. As indicated in Chapter 1, sociobiology is an integrative, ultimate-level theory which can incorporate the main theoretical approaches within developmental psychology, including social learning theory and cognitive-developmental theory. Rather than being a rival to present approaches, sociobiological theory will enrich these approaches as well as lead to many exciting new hypotheses within developmental psychology. This volume is intended as a start in these directions.

Contents

Preface	v
---------	---

Part I. Theoretical Issues

1 The Interfaces Between Sociobiology and Developmental Psychology KEVIN B. MACDONALD	3
2 Resources and Resource Acquisition During Ontogeny WILLIAM R. CHARLESWORTH	24
3 Toward a Developmental Evolutionary Ecology of Humans JAMES S. CHISHOLM	78

Part II. The Domains of Children's Behavior: The Self, Moral Development, Altruism, Aggression, Peer Relations, and Cognition

4 On the Evolution of Self-Knowledge and Self-Deception DENNIS KREBS, KATHY DENTON, and NANCY C. HIGGINS	103
5 Sociobiology and the Cognitive-Developmental Tradition in Moral Development Research KEVIN B. MACDONALD	140
6 Cooperation, Competition, and Altruism in Human Twinships: A Sociobiological Approach NANCY L. SEGAL	168
7 Observations on Adolescence GLENN E. WEISFELD and ROBIN L. BILLINGS	207

- 8 Psychological Development: Epigenetic Rules and
Gene–Culture Coevolution 234
CHARLES J. LUMSDEN

Part III. The Sociobiology of Parent–Child Interactions

- 9 Research in Developmental Sociobiology: Parenting
and Family Behavior 271
MARTIN S. SMITH
- 10 Ultimate and Proximate Determinants of Child
Maltreatment: Natural Selection, Ecological
Instability, and Coercive Interpersonal Contingencies 293
ROBERT L. BURGESS, JEFFREY A. KURLAND,
and EMILY E. PENSKE
- 11 Socialization in the Context of the Family:
A Sociobiological Perspective 320
KEVIN B. MACDONALD
- 12 A Sociobiological Perspective on the Development
of Human Reproductive Strategies 340
PATRICIA DRAPER and HENRY HARPENDING
- 13 Father Involvement, Reproductive Strategies,
and the Sensitive Period 373
JENNY BLAIN and JEROME BARKOW
- Index 397

Contributors

JEROME BARKOW, Department of Sociology and Social Anthropology, Dalhousie University, Halifax, Nova Scotia, Canada

ROBIN L. BILLINGS, Department of Psychology, Wayne State University, Detroit, Michigan, USA

JENNY BLAIN, Department of Sociology and Social Anthropology, Dalhousie University, Halifax, Nova Scotia, Canada

ROBERT L. BURGESS, Department of Individual and Family Studies, The Pennsylvania State University, University Park, Pennsylvania, USA

WILLIAM R. CHARLESWORTH, Institute of Child Development, University of Minnesota, Minneapolis, Minnesota, USA

JAMES S. CHISHOLM, Department of Anthropology, University of New Mexico, Albuquerque, New Mexico, USA

KATHY DENTON, Department of Psychology, Simon Fraser University, Burnaby, British Columbia, Canada

PATRICIA DRAPER, Department of Individual and Family Studies, The Pennsylvania State University, University Park, Pennsylvania, USA

HENRY HARPENDING, Department of Anthropology, The Pennsylvania State University, University Park, Pennsylvania, USA

NANCY C. HIGGINS, Department of Psychology, Simon Fraser University, Burnaby, British Columbia, Canada

DENNIS KREBS, Department of Psychology, Simon Fraser University, Burnaby, British Columbia, Canada

JEFFREY A. KURLAND, Department of Anthropology and Department of Individual and Family Studies, The Pennsylvania State University, University Park, Pennsylvania, USA

CHARLES J. LUMSDEN, Clinical Sciences Division, Medical Sciences Building, Room 7313, University of Toronto, Toronto, Ontario, Canada

KEVIN B. MACDONALD, Department of Psychology, California State University-Long Beach, Long Beach, California, USA

EMILY PENSKY, Department of Individual and Family Studies, The Pennsylvania State University, University Park, Pennsylvania, USA

NANCY L. SEGAL, Department of Psychology, University of Minnesota, Minneapolis, Minnesota, USA

MARTIN S. SMITH, Department of Psychology, Brock University, St. Catharines, Ontario, Canada

GLENN E. WEISFELD, Department of Psychology, Wayne State University, Detroit, Michigan, USA

Sociobiological Perspectives on Human Development

Part I
Theoretical Issues

1

The Interfaces Between Sociobiology and Developmental Psychology

KEVIN B. MACDONALD

This chapter is intended as an introduction to the field of developmental human sociobiology. Its basic purpose is to describe the history of recent evolutionary thought and to illustrate some of the potential contributions to developmental psychology to be gained from a rapprochement with evolutionary theory. In addition, there will be an attempt to integrate the theoretical and empirical research traditions of developmental psychology within an evolutionary framework.

History and Influences in Human Sociobiology

As described below, the field of developmental human sociobiology encompasses a wide range of influences, including Piaget, Bandura, Bowlby, and Wilson. However, since the purpose of the present volume is to emphasize an evolutionary approach, the history and main influences within the sociobiological tradition will be discussed.

The intellectual roots of human sociobiology lie in developments within the evolutionary biology of the 1960s. G. C. Williams (1966) defended the traditional Darwinian idea that natural selection acts at the level of the individual as opposed to the group and inaugurated what has become a major area of empirical and theoretical research in sociobiology. At about the same time William Hamilton (1964a, 1964b) developed the idea that individuals could maximize their fitness not only by maximizing the number of their own offspring but also by extending aid to their genetic relatives. These insights have led to a host of models in which the costs and benefits to an individual are weighted by the coefficient of genetic relatedness between the individual and the recipient of the behavior. Examples of such models appear in this volume (see especially chaps. 6, 7, & 10), but the most influential early models were developed by Robert Trivers. For example, Trivers (1974) developed the model of parent-offspring conflict which essentially delineates a dynamic between the generations which develops because

of asymmetries in genetic self-interest (see Chaps. 10 & 11 for a more detailed account).

These events paved the way for E. O. Wilson's (1975) highly influential work, *Sociobiology: The New Synthesis*. The final chapter of this volume as well as Wilson's (1978) subsequent *On Human Nature* inaugurated the field of human sociobiology. Another major event was the publication of Richard Alexander's (1979) volume *Darwinism and Human Affairs*. Although Alexander argued that the human genetic heritage placed no limits on human social evolution, he also argued that in general human behavior is to be understood as attempting to maximize inclusive fitness and his discussions of a wide range of human social institutions ranging from religion, morality, and legal systems to reproduction and nepotism have been highly influential. Within the social sciences the first substantial body of work attempting to determine the usefulness of sociobiological theory has been in the field of anthropology (see, e.g., Barkow, 1980; Chagnon and Irons, 1979; Kurland, 1979; van den Berghe, 1980). This work has generally attempted to show that human social behavior conforms to the predictions of evolutionary theory.

The incorporation of sociobiological thought into psychology has proved more difficult. Part of the problem is that a central concern of psychological research has always been to discover the proximal mechanisms involved in behavior rather than to ask the ultimate-level questions of the evolutionary biologist. Ultimate-level questions ask why the behavior evolved and generally involve research on the adaptiveness of a behavior or morphological trait. Research on the actual processes which underlie a behavior, such as physiological processes or social learning, is in the realm of proximal mechanisms and need not intersect with the latter investigations at all.

A second reason for the lack of integration between psychology and sociobiology is that sociobiology has been viewed as a theoretical rival rather than a general approach which can be fruitfully integrated with existing psychological theories and research. Sociobiology would indeed be a rival theory if sociobiologists in fact proposed that all human behavior was genetically determined so that psychological theories indicating the importance of environmental effects were necessarily incorrect. However, as the work of Alexander (1979) and others influenced by him illustrates, the role of genes can remain unspecified in a sociobiological theory of behavior. As Kurland (1979) states, "evolutionary biologists who study the evolution of sociality are concerned with the explanation and prediction of how behavior maps onto the environment, *not* how genes map onto behavior" (p. 147). Thus, it is quite possible to review the presently available evidence within a variety of fields in order to determine whether it conforms to the predictions

made by sociobiological theory without specifying the role of genes in producing these behaviors. Indeed, for the most part this is the strategy which will be most apparent in this volume and it is the strategy pursued by other authors attempting to link psychology and evolutionary biology. For example, Youniss (1986) describes reciprocity in children's friendships and shows that in general there is a close correspondence between the available data and the predictions made by evolutionary theory. These studies do not specify the role of genes in producing these behaviors. Nevertheless, sociobiologists remain interested in the epigenetic rules which bias human behavior in particular directions (e.g., Lumsden & Wilson, 1981; Lumsden, this vol., Chap. 8; MacDonald, 1984, 1987, this vol., Chap. 11). Many of these proposed epigenetic rules derive from the ethological tradition in developmental research described below and will figure prominently in sociobiologically influenced work in psychology.

Finally, it should be noted that there are two broad conceptions of sociobiology corresponding to the division in developmental psychology between theories of individual differences, such as behavioral genetics or social learning theory, and theories of central tendencies, such as cognitive-developmental theory and ethology (see McCall, 1981, for a discussion of this distinction). Thus Lumsden and Wilson (1981; see also Lumsden, this vol., Chap. 8) have developed a theoretical approach for discussing the role of genetic variation underlying cultural variation. On the other hand, it is possible to conceive of sociobiology as proposing important genetically based central tendencies in behavior, such as tendencies toward selfishness, and sex differences in reproductive strategy (see, e.g., this vol., Chaps. 5, 7, & 8). These approaches are consistent with each other (MacDonald, 1986c) and can both be used as elements in the explanation and prediction of behavior.

Critical Issues of Sociobiology: Adaptationism, Reductionism, and Genetic Determinism

Sociobiology has come under a great deal of criticism within the scientific community for a variety of reasons. As with any good debate the positions have been polarized, with the result that intellectual compromise is virtually impossible. Moreover, there has often been little realization that within the sociobiological perspective there is considerable diversity of opinion and that in general, sociobiology is a developing theoretical perspective rather than a theory which was written and dogmatized over a decade ago. Without attempting to respond to all of the criticisms that have beset sociobiology, this section will describe a moderate approach to three of the main criticisms of sociobiology.

ADAPTATIONISM

One of the fundamental ideas underlying an evolutionary approach to behavior is that through the process of natural selection organisms become adapted to their environments. Questions of ultimate causation are essentially questions of how a behavior is or was adaptive for the organism at some point in its phylogeny. For example, Bowlby (1969, 1973) theorized that the ultimate cause of attachment behavior in infants was the avoidance of predators and that this was accomplished by proximal mechanisms tending to keep the infant fairly close to the mother.

Such an explanation seems reasonable and, in the absence of competing hypotheses, it should be accepted. As an alternative, one could propose, for example, that the affective bonding process that attachment represents was the result of natural selection for closer family ties and hence greater paternal investment in offspring. These two possibilities, then, represent empirical propositions regarding the evolutionary history of this behavior, and it is quite possible that data could be found which would tend to confirm or disconfirm either of them. If, for example, it were shown that predation on infants is not likely to be a major focus of natural selection on human populations during the proposed period, the predation hypothesis would be disconfirmed. Since the publication of Wilson's (1975) seminal work, dozens of empirical studies have been performed with animals in attempts to verify sociobiologically influenced adaptationist hypotheses, and prior to this one of the main interests of the traditional ethologists was to discover how a behavior was adaptive for an animal. This interest in adaptation continues to attract a great deal of interest (see, e.g., Emlen, 1984, for a review of the literature on the adaptiveness of helping behavior in scrub jays).

There is no reason, therefore, to suppose that adaptationism per se is unscientific or that it inevitably leads to "just so" stories. Adaptationist hypotheses can be supported by discovering patterns of data to which they conform. Since the beginning of human sociobiology, many studies have been done by examining existing data sets in anthropology and the social sciences for conformity with adaptationist hypotheses (e.g., Alexander, 1979; see also Weisfeld & Billings, this vol., Chap. 7). The fact that these data sets often do conform significantly to sociobiological predictions is good evidence for the adaptationist perspective, especially since the data were not gathered by researchers influenced at all by the theory. It should be noted, however, that the great majority of the material in this volume does not depend on adaptationist hypotheses for its value. Instead, the great majority of the material is an attempt to determine whether human behavior conforms to the predictions made by evolutionary theory, independent of its present adaptiveness and

independent of providing detailed hypotheses about human evolutionary history.

One difficulty for the adaptationist perspective in human sociobiology is to develop a reasonable sense of adaptation. In many cases the Darwinian fitness of behavioral alternatives is unknown, although there are significant exceptions (MacDonald, 1986c). Another problem is that social controls on reproduction are a highly salient factor in Westernized societies so that differences in fitness tend to be minimized and relatively unrelated to the control of resources as in traditional societies (MacDonald, 1983; see also this vol., Chap. 11). That a strong connection between the control of resources and reproductive success as well as sexual competition among males is crucially important in understanding traditional human cultures can hardly be doubted (Dickemann, 1979; Hartung, 1976; Hill, 1984; Irons, 1979; MacDonald, 1983; see also this vol., Chap. 11) and constitutes one of the major triumphs of the sociobiological approach in anthropology.

In addition to Darwinian fitness, social class and upward and downward social mobility are important dependent variables in sociobiological analysis. High socioeconomic class is associated with relative wealth and political power, both of which are associated with reproductive success in traditional societies. Moreover, high social class status and control of resources facilitates engaging in sociobiologically predicted behavior, e.g., male reproductive behavior (MacDonald, 1986c; see also this vol., Chap. 11). From this perspective developmental factors associated with social and cognitive functioning which are in turn related to social mobility become important aspects of a sociobiological analysis (see Chap. 11).

Nevertheless, behavior need not always be adaptive. There are many reasons for this, not the least of which is that evolution is an ongoing process so that there is continuing natural selection against maladaptive behavior. Barkow (1986) has described several ways in which maladaptive behavior can occur in human societies, including conflict among factions, the accumulation of misinformation, ecological change, and negative side effects of otherwise fitness-enhancing cultural traits. Within a psychological perspective, maladaptive behavior can occur for a variety of reasons, including the five discussed below.

1. Genetic Variation

Although we suppose that as a general rule humans behave in an adaptive manner, genetic variation within the human population evidently predisposes some individuals to debilitating physical and psychiatric conditions. For example, vulnerability to schizophrenia has a genetic basis (Gottesman & Shields, 1982), and schizophrenics have a lowered fertility compared to the population as a whole (Price, Slater, & Hare,

1971; Reed, 1971; Slater, Hare, & Price, 1971) as well as downward social mobility relative to their own fathers (Dunham, 1965; Goldberg & Morrison, 1963; Turner and Wagonfeld, 1967). Various mechanisms occur which tend to result in individuals with genes predisposing them to maladaptive behavior. Burgess, Kurland, and Pensky (this vol., Chap. 10) point out that some behaviors may be by-products that are the result of natural selection for other traits. In addition, genetic variation underlying dimensions of personality may be adaptive because it yields a diversity of phenotypes which are more or less adaptive in particular environments. Random processes and assortative mating can then lead to extreme genetic combinations which are maladaptive in any environment. Thus, variation in aggressiveness may be the result of the fact that there is no one optimal level of aggressiveness in humans and this variation may lead via random processes and assortative mating to pathologically high or low levels of aggression in individuals.

2. Secondary Effects of Sociobiologically Predicted Central Tendencies

In some cases the result of individuals' acting to maximize their adaptiveness is a decrement in adaptiveness to others. For example, a sociobiological theory of divorce predicts that, in the absence of social controls, there will be a tendency for males to maximize their reproductive success by leaving behind one family and forming another with a younger female. One consequence of this behavior is a tendency for a decrement in adaptiveness in the behavior of the children of the first marriage (see this vol., Chap. 11 for a complete account). Thus, the sociobiologically predicted central tendency for individuals to maximize their own fitness can result in less than maximum adaptation for their offspring, an aspect of parent-offspring and parent-parent conflict over parental investment.

3. Cultural Change Resulting in Maladaptive Consequences for Formerly Adaptive Behavior

The epigenetic rules which influence human behavior presumably evolved for the most part during the prolonged prehistoric phase of human evolution. The recent surge in human culture leaves open the possibility that these epigenetic rules could result in maladaptive behavior within present human cultures. For example, Alexander (1979) proposes that since children are now socialized at an early age with non-relatives they may be more altruistic towards them than predicted by an adaptationist theory (see Chap. 11 for further examples).

4. Social Controls

Social controls on individual behavior can be effective independent of an individual's genotype and can result in decrements in the adaptiveness

of behavior. Social controls are extremely important in understanding human behavior, especially in the economically advanced societies, and can often have important effects on child development. Social controls affecting family structure and the socialization of children are discussed in Chapter 11.

5. Pathological Environmental Influences

Pathological environmental influences are entirely consistent with a sociobiological perspective. Indeed, the ethological idea of an evolutionarily expected environment implies that pathological behavior can result from environments that do not conform to those expected by the organism (see Chap. 11 for a more detailed discussion). For example, McGuire and Troisi (1987) have provided evidence that “certain types and frequencies of social interactions *are essential* to maintain normal physiological function”, and that “changes in certain physiological functions. . . result in unpleasant symptoms and, if the alterations persist, an increased probability of psychiatric disorders” (p. 10S) (*italics in text*). Thus individuals who are chronically exposed to environments which do not provide adequate levels of recognition, affection, respect and social support are prone to develop psychiatric disorders, some of which are debilitating and maladaptive.

Another way to view these relationships is within the framework of resource theory as developed by Charlesworth (see Chap. 2) and as exemplified by chapter 10 by Burgess, Kurland, and Pensky on child maltreatment. When economic or affective resources are inadequate, tremendous stress is placed on the individual and the social group, and behavior can become an index of pathology rather than an adaptive response to the environment.

In addition, there is a large literature within developmental psychology on plasticity. Lerner (1984) and MacDonald (1985) have emphasized the “double-edged sword” of human plasticity: Although human plasticity allows for great adaptability to changing environments as well as an openness to a very complex enculturation process, it also leaves open the possibility that individuals will be pathologically influenced by these environments. This is particularly true in the case of environments that depart radically from normative environmental variation (MacDonald, 1985, 1986a, 1986b). There is also evidence that humans exhibit declining plasticity as they get older (MacDonald, 1985, 1986a), so that if individuals are not exposed to intensive remediation of early environmental insults, long-term pathological outcomes are likely.

In sum, an adaptationist hypothesis is an empirical proposition which is open to reasoned discussion. Alternative hypotheses, including the possibility that the behavior is maladaptive, can be reasonably considered and data can be marshaled to support the various alternatives. It

should also be said that although a healthy skepticism regarding particular hypotheses is praiseworthy, there should be an *a priori* assumption that some adaptationist hypothesis or other is in fact correct. An evolutionary approach demands the belief that although pathology is always possible there will be a strong central tendency toward the adaptiveness of behavior. Too often the critics of sociobiology, while not denying the principle of adaptationism, are completely unwilling, seemingly so in principle, to accept any concrete human examples as being adaptive.

REDUCTIONISM AND GENETIC DETERMINISM

There are two versions of reductionism which have been considered by various writers, neither of which must be accepted from a sociobiological point of view. One version is that the behavior of groups can be reduced to the behavior of individuals which can in turn be characterized in terms of biological central tendencies toward selfishness, etc. Such a point of view ignores phenomena such as social controls discussed above (see also MacDonald, 1983, 1987, this vol., Chap. 11), which can act to restrain individual behavior independent of its adaptiveness. Social controls can be egalitarian or antiegalitarian, and the direction of these controls, and even their existence, cannot be predicted by any biological theory (MacDonald, 1983, 1987).

Another version of reductionism is the idea that adaptive behavior is the result of natural selection and thus genetically determined. Such a viewpoint ignores the role of environmental variation in producing adaptive phenotypes and the general point that the adaptiveness of behavior is often highly context dependent. The above discussion of maladaptive behavior presents examples of both possibilities.

The adoption of an antireductionistic point of view is not equivalent to throwing out the essence of sociobiology. Human adaptation can be seen as strongly influenced by sociobiologically predicted, genetically based central tendencies toward selfishness, etc., as well as by environmental variation interacting with environment-expectant genetic systems as well as a variety of contextual variables. Such a viewpoint is not reductionistic, but it does have the virtue of conforming to many findings in the study of human development as well as to the reality of human social organizations. In general, with the exception of Nancy Segal's work (see Chap. 6) implying genetic variation for cooperation, competition, and altruism, this book contains no detailed accounts of genetic processes underlying behavior. The first stage of a sociobiological analysis is to specify the development of adaptive and maladaptive phenotypes. The genetic analysis of the epigenetic rules which bias individuals toward particular behaviors will be the next step. Given the general findings in human behavior genetics for the importance of genetic variation in human behavior, there is every reason to suppose that (1) there

will be important genetic variation for adaptive and maladaptive human behaviors, and (2) there are strong, genetically based central tendencies toward sociobiologically predicted behavior in humans. However, even if genetic variation and genetically based central tendencies prove to be irrelevant, the present endeavor is still essential.

Sociobiology and the Theoretical and Empirical Traditions of Developmental Psychology

This section discusses several of the major theoretical and empirical traditions of developmental psychology within a sociobiological perspective. The emphasis throughout is on the consistency of sociobiology with the major theoretical approaches within developmental psychology and on the benefits of theoretical integration rather than conflict and inconsistency. The common thread of the discussion is the emphasis on the ecological context of development and the adaptiveness of behavior.

ETHOLOGICAL THEORY

In the biological study of animal behavior, ethology is the intellectual forerunner of sociobiology. Ethologists emphasize the adaptiveness of behavior as well as the genetic basis of many behaviors, and these themes have been retained by the sociobiological perspectives illustrated in this volume. Most essentially, sociobiology will result in an extension of Darwinian approaches to new domains as well as in a broader perspective for areas already influenced by ethological theory.

The main areas of influence of the ethological perspective have been restricted to attachment theory and research and the interest in dominance relations among children. Sociobiology extends the scope of the adaptationist approach to include some of the central areas of social and cognitive development. Because of the fundamental concern with the costs and benefits involved in human relationships, the areas of moral development and altruism become central areas of the adaptationist approach (chaps. 4, 5, & 6). This concern is also reflected in sociobiological approaches to peer relationships (Youniss, 1986; Weisfeld & Billings, this vol., Chap. 7) and parent-child interactions (chaps. 9-13). Moreover, the emphasis of Lumsden (Chap. 8) on attempting to delineate and classify the fundamental epigenetic rules of humans and how these rules influence cultural choices has a broad synthetic influence in many areas of cognitive and social development. More generally, and as reflected particularly in the work of Charlesworth (this vol., Chap. 2), the influence of sociobiology is reflected in a new tendency to place all of behavior within an adaptationist framework independent of the particular proximal mechanisms involved. Sociobiology, unlike ethology

and as previously described, need not emphasize genetic explanations of behavior. The entire behavioral phenotype and its adaptive significance in particular environments is the unit of analysis.

Moreover, sociobiology enables theorists to better incorporate traditional ethological approaches with cross-cultural and historical data by emphasizing sociobiologically derived contextual variables. Ethologically influenced analyses, like developmental psychology in general, have tended to be static accounts of behavior within a particular society. Cross-cultural data are gathered in order to study the universality of developmental hypotheses. A sociobiological perspective emphasizes the influence of contextual variables such as resource availability (Charlesworth, Chap. 2 this vol.), economic production, and social controls as well as sexual competition among males and biological relatedness in influencing the variation found in affective relationships within the family, socialization of children, and peer relationships (see Chap. 11). This broadening of perspective will do much to make historical and cross-cultural data central rather than peripheral to developmental theory.

The ethological approach, particularly the ethological theory of attachment, will also have an influence on sociobiological approaches to human development. Bowlby's (1969, 1973) ethological theory of attachment remains a paradigm of a modern developmental theory because of its emphasis on (1) the adaptiveness of behavior and the idea of the environment of evolutionary adaptiveness; (2) the idea of "natural clues" (epigenetic rules in the sense of Lumsden); (3) the idea of an evolutionarily expected environment, which provides for an evolutionary basis for strong environmental influences in development; (4) the general emphasis on the interaction among cognitive, affective, perceptual, and motor systems in attachment theory; and finally (5) the ramifications of attachment for behavior in a wide variety of domains including peer relationships, cognitive style, adult attachments, etc. The centrality of theories such as that of Bowlby for an evolutionary theory of behavior provide a degree of complexity and subtlety to sociobiological analysis which clearly avoids the often stated criticism that sociobiological models are simplistic genetic models which cannot incorporate the complexity of psychological development. In the study of gene-culture coevolution, models such as this will be essential, and indeed such a model has already been applied to several areas of human development within a sociobiological perspective (MacDonald, 1984, 1987; see also this vol., Chap. 11).

SOCIAL LEARNING THEORY

Social learning theory remains a dominant tradition within developmental psychology, and sociobiological theory would not tend to lessen

this influence. Sociobiological views of social learning (Barkow, 1986; Lumsden & Wilson, 1981; MacDonald, 1984, 1987; Pulliam & Dunford, 1980) have coincided with those of writers within the traditional psychological framework (e.g., Bandura, 1969, 1977) in emphasizing the adaptiveness of social learning and its usefulness in transmitting cultural values. Sociobiological accounts, however, emphasize the fact that the adoption of a particular culturgen (Lumsden & Wilson, 1981) via social learning or via any other method of cultural transmission often has implications for the Darwinian fitness of individuals adopting the cultural variant.

Social learning theory derives from the long behaviorist tradition in empiricist psychology, and as a result social learning theorists stress the importance of the consequences of the behavior to the actor. Although learning can occur without reinforcement, it is fundamental to the social learning perspective that individuals are more likely to engage in behaviors which are rewarded. Such a viewpoint implies the existence of self-interest as a prime human motivator, as predicted by sociobiological theory, and this state of affairs is reflected in the tendency for social learning theorists to attempt to find reinforcement contingencies which underlie even apparently self-sacrificing behavior (e.g., Gelfand & Hartman, 1982). Indeed, the tendency toward self-interested behavior stands almost as an unanalyzed bedrock in developmental psychology, while much research is devoted to fostering the small amount of altruism which is actually found (see Chap. 5). That much of human behavior should be analyzable in terms of seeing individuals as performing rough cost/benefit analyses in guiding their actions toward needed resources should come as no surprise to individuals within the social learning tradition.

Social learning theory will benefit from a sociobiological viewpoint by adopting a more behavioral-ecological perspective, a perspective in which the epigenetic rules affecting social learning are given a large role and in which sociobiologically predicted contextual variables are considered. Several of the factors that have been shown to affect social learning may well involve epigenetic rules which constrain social learning and, in conjunction with various contextual variables, affect the adaptiveness of social learning.

Regarding the importance of epigenetic rules which affect social learning, several characteristics of the model appear to facilitate social learning, including the warmth, power, similarity, and competence of the model (Mischel, 1976). MacDonald (1984, 1987; see also this vol., Chap. 11) has argued that the warmth of the model is of considerable importance in affecting social learning within the family. Warm parent-child relationships appear to facilitate the effects of modeling on children, and it is argued that these effects are the result of the interaction between social learning and the epigenetic rules which influence the

affective impact of parental behaviors on children. Thus parent behaviors labeled warm obtain their affective valence via the operation of epigenetic rules characteristic of children. Moreover, the adaptiveness of familial affective relations varies in sociobiologically predicted ways with changes in economic production and sexual competition. One of the tasks of future research will be to determine how the tremendous cross-cultural variation in familial affective relationships in conjunction with contextual variables such as social controls affects social learning within the family.

The facilitative effect of the power, competence, and similarity of the model may well also be the result of epigenetic rules affecting modeling and, in any case, have clear effects on adaptive behavior. Barkow (1986) has found that the Migili (Koro) of Nigeria quickly rejected their traditional leaders and religion when exposed to Western influences associated with power, competence, and prestige. On the other hand, teenagers who adopt the behavior of wealthy, powerful models who have children out of wedlock may be behaving maladaptively (MacDonald, 1987). These examples suggest the importance of contextual variables within an adaptationist perspective, a point that is returned to below.

COGNITIVE-DEVELOPMENTAL THEORY

Cognitive-developmental theory has the potential of becoming a rich source of ideas for a sociobiological analysis of development. As many authors have pointed out, Piaget's conception of development was fundamentally biological. Flavell (1985) notes that if one wants to understand how Piaget conceived the child, one simply has to ask how evolution would have designed an optimal learning machine. First, the child should be equipped with intrinsic motivation which, from an adaptationist perspective, would involve epigenetic rules which affect the reward value of behaviors involved in learning about the world. Second, the child should be designed so that the basic processes of cognitive development will depend on very general features of the environment (Kohlberg, 1969) and thus not be dependent on a narrow range of environmental contingencies which may or may not occur (Kagan & Klein, 1973; MacDonald, 1986a, 1986b; Scarr & McCartney, 1983). The system should be fairly well buffered from environmental effects, and this appears to be the case.

By far the greatest contribution of the cognitive-developmental approach is the description of the main trends of human development. Cognitive-developmental research and theory are relatively unconcerned with individual differences (McCall, 1981) and in this regard they are similar to one of the main strands of sociobiological theory. Much of sociobiologically inspired research attempts to describe some of

the main trends of human social development, such as the tendency toward selfishness and the tendency to help relatives. Within an adaptationist perspective, the broad features of the environment necessary for normal cognitive development constitute an evolutionarily expected environment, and the organismic attributes necessary to take advantage of this environment constitute species-wide genetic invariance. Indeed, as described above, the fundamental program of human sociobiology can be accomplished without assuming any genetic variation at all: As in developmental psychology one can construct sociobiological models which emphasize genetic variation and individual differences (e.g., Lumsden & Wilson, 1981) and those which emphasize sociobiologically predicted central tendencies and ignore individual differences (MacDonald, 1986c). These models, like the corresponding models within developmental psychology, can be construed so that they are consistent with each other.

As illustrated in chapter 5 of this volume, however, a sociobiological approach makes quite different predictions regarding the conduct of moral reasoning than predictions made by some cognitive developmental researchers and theorists, particularly Lawrence Kohlberg. A sociobiological approach need not question teleological views of development in general, but it must question those which conflict with the main characteristics and goals of human behavior as predicted by sociobiological theory. Thus, sociobiological theory is consistent with a general tendency for development to proceed in a general direction of greater competence but not one in which the endpoint of development is described as involving movement toward more and more selfless behavior. Moreover, as described in Chapters 4 and 5, sociobiological theory predicts that in general, reasoning about actions will be strongly influenced by sociobiologically predictable contextual variables such as cost-benefit contingencies and biological relatedness, and that it will generally operate in an adaptive manner. Thus self-deception and the manipulation of others are expected to occur in the context of reasoning about real-life problems.

A sociobiological analysis thus focuses on conflicts of interest and the role of cognitions in these conflicts. For example, sociobiologically influenced research stemming from attribution theory will attempt to determine the role of attributions in controlling the behavior and affective states of others. Excuse-making and the study of deception (both of oneself and of others) become an important area of study. As an example of this type of research, Weiner and Handel (1985) showed that even young children (ages 5 to 7) are quite aware of some of the major dimensions of attributions (internal versus external, controllable versus uncontrollable) and that as children become older they are more likely to use attributions to manipulate another individual's affective state.

BEHAVIORAL GENETICS

Behavioral genetics is not really a theory of development but is a method used to understand the relative contribution of genetic variation and environmental variation to total phenotypic variation in a population. Although it is derived from population genetic theory, behavioral genetic methodology does not address the issue of adaptiveness which is central to sociobiology and ethology. Behavioral genetics is a method for understanding the origins of individual differences within a population rather than for understanding the invariant main trends of development. As Plomin and DeFries (1985) point out, the great majority of information coded in the genes may be invariant and thus not analyzable by behavioral genetic means, whereas these central, genetically based tendencies are fundamental to sociobiological analyses. However, as indicated above, genetic variation underlying variation in human epigenetic rules is essential to theories such as that of Lumsden and Wilson (1981), and estimates of heritability of these rules will be necessary in order to carry out this program of research. Thus, behavioral genetics will become an important tool for sociobiological research, and in the present volume Segal (Chap. 6) shows how behavioral genetic methodology can be used to study cooperation, competition, and altruism. Similarly, Rushton, Fulker, Neale, Nias, and Eysenck (1986) have shown genetic variation for altruism and aggression.

In addition, Segal (Chap. 6) points out that traditional behavioral genetic research viewed twins as individual pair members whose scores were correlated and compared with other groups with different degrees of genetic relatedness. With the introduction of sociobiological thinking, the focus is shifted to the social group. Specific hypotheses regarding the cooperation, competition, and altruism of individuals *with each other* depending on the degree of their genetic relatedness become researchable and theoretically relevant issues, and a quite different methodology must be developed to study these hypotheses. Rather than studying the sources of variation of altruism in a population viewed as consisting of independently existing individuals subjected to independently existing environments, the focus shifts to studying how the genetic relatedness of the individuals in a particular context influences altruism.

CONTEXTUALISM

Recently developmentalists have become more aware of the importance of contextual factors in human development (e.g., Bronfenbrenner, 1977; Lerner & Kaufman, 1986). Development is seen as embedded in a rich web of interactions among different levels of analysis. For example, events occurring at the level of the entire society, such as an economic depression, affect family interaction patterns and these in turn affect

child development. One of the advantages of a nonreductionistic sociobiology, as illustrated above, is that it provides a means of understanding processes which occur at levels higher than the individual. An example of an important contextual variable from a sociobiological perspective is the social control of individual behavior. Individuals are not always free to engage in behavior which maximizes their fitness due to the constraints placed on individual behavior by others. As indicated above, these constraints can be quite insensitive to genetic variation among those to whom they apply, can have egalitarian or antiegalitarian effects on human behavior, and are not predictable from any purely biological theory (MacDonald, 1983, 1987).

There are many examples of the effects of social controls on human development, perhaps the most important being those relating to family structure (MacDonald, 1983, 1987; see this vol., Chap. 11). Other important contextual variables from a sociobiological perspective include the level of available resources, economic production, and external ecological contingencies (MacDonald, 1983, 1987). In general, a sociobiological perspective expects historical and cross-cultural variation in response not only to external ecological contingencies but also to internal social dynamics based on conflicts of interest between individuals and groups. In our own society the social controls on individual behavior resulting from this dynamic are a chronic political issue.

Circumstances which affect the adaptiveness of a behavior in a particular situation constitute another type of contextual variable which is emphasized by sociobiological theory. From this perspective, for example, moral reasoning does not occur in a cognitive vacuum but is importantly influenced by contextual factors such as the biological relatedness of the persons affected by the decision and cost-benefit considerations (see Chap. 5). Human behavior is clearly quite flexible and responsive to changing contexts rather than rigid and stereotyped as in many animals. A sociobiological approach to human behavior will result in placing many of the contextual variables found relevant in empirical research within a wider theoretical perspective.

CROSS-CULTURAL RESEARCH

The incorporation of sociobiological theory into developmental psychology will result in an increased emphasis on cross-cultural research. As emphasized in the discussion of ethological theory (see above), sociobiological theory has the potential of enriching cross-cultural research by providing explanations of cross-cultural variation which incorporate sociobiologically derived variables. Thus research will be aimed not only at verifying the existence of central tendencies in human behavior as a universal phenomenon, but also at illustrating the adaptiveness of patterns of child-rearing and other influences on development within

particular cultural contexts. Such studies can be expected to result in conclusions on the importance of environmental effects in human development and, indeed, such analysis may result in some of the best evidence for environmental effects on child development. Konner (1981) has noted that cross-cultural variation in behavior tends to be far greater than within-culture variation and thus constitutes an ideal laboratory for testing adaptationist hypotheses. If cultural change occurs too rapidly to be due to natural selection acting on genetic variation, there is strong evidence in favor of purely cultural change. Thus, MacDonald (1984) has argued that the patterns of familial affective relations are associated in predictable ways with sociobiologically expected contextual variables and patterns of sexual competition, thus indicating their adaptiveness. However, there is also evidence that these patterns can change too quickly to be due to natural selection acting on genetic variation.

CONCLUSION

The above outline indicates that sociobiological considerations can be successfully integrated with the main empirical and theoretical traditions of developmental psychology. A sociobiological approach will generally add the dimension of adaptiveness to developmental research. Moreover, the focus on conflicts and confluences of interest will have a broad impact on analyses of family and peer functioning and social cognition, especially that involved in moral reasoning, altruism, and peer relations. The behavior of adults toward children will also be illuminated, particularly regarding phenomena such as differential parental solicitude, patterns of child abuse, and the secondary effects of adult sexual behavior. Moreover, there will be an increased emphasis on describing the fundamental epigenetic rules underlying human behavior and how these rules influence behavior in a wide variety of domains. Most broadly, the sociobiologically predicted central tendencies in human behavior will assume central importance, particularly the tendency toward self-interest and the importance of genetic relatedness as a modifier of human behavior. Finally, the contextual variables shown to be important to human development will be placed in a wider evolutionary context.

What Sociobiology Can't Do

Although sociobiology provides a number of significant hypotheses relevant to developmental psychology and places much of the data on social development within a broader evolutionary perspective, it sheds no light on the specific mechanisms involved. There is no methodology

derived from sociobiological theory which will tell us the relative contribution of genes and environment to the development of selfishness. The theory only tells us that selfishness is an important phenotype. The theory is fully consistent with the importance of social learning in human development, but it does not state which epigenetic rules will affect social learning or the degree of their heritability. However, sociobiological as well as ethological theory (Bowlby, 1969, 1973; Lumsden & Wilson, 1981) lead to the expectation that human development will not be fruitfully characterized as proceeding from a *tabula rasa*. At this point, however, such views have become rare among developmental psychologists, the result of a decade of research by behavioral geneticists and other mainstream biologically oriented researchers.

It might be said that although sociobiology provides hypotheses relevant to understanding children, it provides few significant hypotheses relating to human *development*. Many of the hypotheses derived from the theory tend not to single out age as an important variable, with the exception of discussions cast in terms of reproductive value (see Chaps. 3, 7, 9, & 10). This is, of course, an important exception, but nevertheless it might be said that the ecological niche of the child is not well specified with respect to the importance of age as a variable. The evolution of children's behavior has occurred within the presence of adults who are able to control and make decisions regarding the behavior of their children. A preschool child who cannot conserve number would be at a great disadvantage in dealing with a conserving adult stranger, but in fact parents form a buffer between the developing competencies of the child and the world. Children must therefore be viewed as adapted to the context of the family.

Being adapted to the context of a family, however, is consistent with a wide range of competencies and behaviors. For example, it is consistent with a complete lack of continuity in development so that the skills and competencies of the child which adapt it to the protected family environment are totally abandoned in adulthood when real-world problems must be faced. From this perspective it would not be surprising to find a very altruistic child, a child who would give everything to anyone and who is suddenly replaced by a scheming, self-interested adult. As an example of this perspective, Weisfeld and Berger (1983) emphasize the lack of continuity between childhood and adolescence within a sociobiological perspective. Young children with their small physical size are said to occupy a qualitatively different ecological niche than adolescents, with the latter showing a sudden growth spurt, the onset of sexual competence, and a tendency to seek a greater influence in the affairs of the family.

The actual degree of continuity found is, of course, an empirical question, but there is evidence, reflected in the discussions in several of the chapters of this volume for important continuities in sociobiologically

relevant behavior as well. Thus, whatever the developmental fluctuations in selfishness and resource allocation behaviors and in spite of how these behaviors are rationalized (see Chaps. 2, 4 to 6), it is clear that they vary around a generally self-interested mean. In addition, Weisfeld and Billings (Chap. 7) show strong continuity in male dominance throughout childhood. As indicated above, the degree of adaptation to the environment as well as what environment the child is adapting to are empirical questions. Sociobiologically inspired research must ask some of the same questions asked by other researchers: If Piaget had not invented the scientific description of the development of moral reasoning in children, sociobiologists would surely have had to invent it.

Conclusion

The main message of the foregoing discussion is the essential compatibility of sociobiology with the mainstream theoretical and empirical research of developmental psychology. The incorporation of sociobiological thought into developmental psychology will enrich a great many areas, particularly areas of social development, but also those relevant to the intersection of cognitive and social development. In a sense it is surprising that over 100 years after Darwin's work made evolutionary theory the fundamental paradigm of life on earth there remains so much work to be done to fully incorporate this theoretical structure into the mainstream of the scientific study of human development. The essays in this volume are intended to rectify this gap.

Acknowledgments. I wish to thank William Charlesworth and Michael McGuire for critical readings of the manuscript and their helpful suggestions.

REFERENCES

- Alexander, R. (1979). *Darwinism and human affairs*. Seattle: University of Washington Press.
- Bandura, A. (1969). Social learning theory of identificatory processes. In D.A. Goslin (Ed.), *Handbook of socialization theory and research*. Chicago: Rand-McNally and Co.
- Bandura, A. (1977). *Social learning theory*. Englewood Cliffs, NJ: Prentice-Hall.
- Barkow, J. (1980). Biological evolution of culturally patterned behavior. In J. Lockard (Ed.), *The evolution of human social behavior*. New York: Elsevier.
- Barkow, J. (1986, May). *The elastic between genes and culture*. Paper presented at a conference entitled "Evolutionary constraints on human culture," UCLA, Los Angeles, CA.

- Bowlby, J. (1969). *Attachment*. New York: Basic Books.
- Bowlby, J. (1973). *Separation and loss*. New York: Basic Books.
- Bronfenbrenner, U. (1977). *The ecology of human development*. Cambridge: Harvard University Press.
- Chagnon, N., & Irons, W. (Eds.). (1979). *Evolutionary biology and human social behavior*. North Scituate, MA: Duxbury Press.
- Dickemann, M. (1979). Female infanticide, reproductive strategies and social stratification: A preliminary model. In N. Chagnon & W. Irons (Eds.), *Evolutionary biology and human social behavior*. North Scituate, MA: Duxbury Press.
- Dunham, H.W. (1965). *Community and schizophrenia*. Detroit: Wayne State University Press.
- Emlen, S.T. (1984). Cooperative breeding in birds and mammals. In J.R. Krebs & N. Davies (Eds.), *Behavioral ecology: An evolutionary approach* (2nd ed.). Sunderland, MA: Sinauer.
- Flavell, J. (1985). *Cognitive development* (2nd ed.). Englewood Cliffs, NJ: Prentice-Hall.
- Gelfand, D.M., & Hartmann, D.P. (1982). Response consequences and attributions: Two contributors to prosocial behavior. In N. Eisenberg (Ed.), *The development of prosocial behavior*. New York: Academic Press.
- Goldberg, E.M., & Morrison, S.L. (1963). Schizophrenia and social class. *British Journal of Psychiatry*, 109, 785-802.
- Gottesman, I., & Shields, J. (1982). *Schizophrenia: The epigenetic puzzle*. New York: Cambridge University Press.
- Hamilton, W.D. (1964a). The genetical evolution of social behavior I. *Journal of Theoretical Biology*, 7, 1-16.
- Hamilton, W.D. (1964b). The genetical evolution of social behavior II. *Journal of Theoretical Biology*, 7, 17-52.
- Hartung, J. (1976). Natural selection and the inheritance of wealth. *Current Anthropology*, 17, 607-622.
- Hill, J. (1984). Prestige and reproductive success in man. *Ethology and Sociobiology*, 5, 77-95.
- Irons, W. (1979). Cultural and biological success. In N. Chagnon & W. Irons (Eds.), *Evolutionary biology and human social behavior*. North Scituate, MA: Duxbury Press.
- Kagan, J., & Klein, R. (1973). Cross-cultural perspectives in early development. *American Psychologist*, 28, 947-961.
- Kohlberg, L. (1969). Stage and sequence: The cognitive-developmental approach to socialization. In D.A. Goslin (Ed.), *Handbook of socialization theory and research*. Chicago: Rand McNally and Co.
- Konner, M. (1981). Evolution of human behavior development. In R.H. Munroe, R.L. Munroe, & B.B. Whiting (Eds.), *Handbook of cross-cultural human development*. New York: Garland Press.
- Kurland, J. (1979). Paternity, mother's brother, and human sociality. In N. Chagnon & W. Irons (Eds.), *Evolutionary biology and human social behavior*. North Scituate, MA: Duxbury Press.
- Lerner, R.M. (1984). *On human plasticity*. New York: Cambridge University Press.

- Lerner, R.M., & Kauffman, M.B. (1986). The concept of development in contextualism. *Developmental Review*, 6, 309–333.
- Lumsden, C., & Wilson, W.O. (1981). *Genes, mind and culture*. Cambridge: Harvard University Press.
- MacDonald, K. (1983). Production, social controls and ideology: Toward a sociobiology of the phenotype. *Journal of Social and Biological Structures*, 5, 297–317.
- MacDonald, K. (1984). An ethological-social learning theory of the development of altruism: Implications for human sociobiology. *Ethology and Sociobiology*, 5, 97–109.
- MacDonald, K. (1985). Early experience, relative plasticity, and social development. *Developmental Review*, 5, 99–121.
- MacDonald, K. (1986a). Early experience, relative plasticity and cognitive development. *Journal of Applied Developmental Psychology*, 7, 101–124.
- MacDonald, K. (1986b). Developmental models and early experience. *International Journal of Behavioral Development*, 9, 175–190.
- MacDonald, K. (1986c, May). The plasticity of human social organization and behavior: Contextual variables and proximal mechanisms. Paper presented at a conference entitled “Evolutionary constraints on human culture,” UCLA, Los Angeles, CA.
- MacDonald, K. (1987). Biological and psychosocial interactions in early adolescence: A sociobiological perspective. In R.M. Lerner & T.T. Foch (Eds.), *Biological and psychosocial interactions in early adolescence: A life span perspective*. Hillsdale, NJ: Lawrence Erlbaum Associates.
- McGuire, M., & Troisi, A. (1987). Physiological regulation-deregulation and psychiatric disorders. *Ethology and Sociobiology*, 8, 9S–25S.
- McCall, R. (1981). Nature-nurture and the two realms of development: A proposed integration with respect to mental development. *Child Development*, 52, 1–12.
- Mischel, W. (1976). *Introduction to personality* (2nd ed.). New York: Holt, Rinehart and Winston.
- Plomin, R., & DeFries, J. (1985). *The origins of individual differences*. New York: Academic Press.
- Price, J.S., Slater, E., & Hare, E.H. (1971). Marital status of first admissions to psychiatric beds in England and Wales in 1965 and 1966. *Social Biology* 18, S74–S94.
- Pulliam, H.R., & Dunford, C. (1980). *Programmed to learn*. New York: Columbia University Press.
- Reed, S. (1971). Discussion: Mental illness and reproduction. *Social Biology*, 18, S95–S102.
- Rushton, J.P., Fulker, D.W., Neale, M.C., Nias, D.K.B., & Eysenck, H.J. (1986). Altruism and aggression: The heritability of individual differences. *Journal of Personality and Social Psychology*, 50, 1192–1198.
- Scarr, S., & McCartney, K. (1983). How people make their own environments: A theory of genotype-environment effects. *Child Development*, 54, 424–435.
- Slater, E., Hare, E.H., & Price, J.S. (1971). Marriage and fertility of psychiatric patients compared with national data. *Social Biology*, 18, S60–S73.
- Trivers, R. (1974). Parent-offspring conflict. *American Zoologist*, 14, 249–264.

- Turner, R.J., & Wagenfeld, M.O. (1967). Occupational mobility and schizophrenia: An assessment of the social causation and social selection hypotheses. *American Sociological Review*, 32, 104-113.
- van den Berghe, P. (1979). *Human family systems*. New York: Elsevier North Holland.
- Weiner, B., & Handel, S.J. (1985). A cognition-emotion-action sequence: Anticipated emotional consequences of causal attributions and reported communication strategy. *Developmental Psychology*, 21, 102-107.
- Weisfeld, G.E., & Berger, J.M. (1983). Some features of human adolescence viewed in evolutionary perspective. *Human Development*, 26, 121-133.
- Williams, G.C. (1966). *Adaptation and natural selection*. Princeton, NJ: Princeton University Press.
- Wilson, E.O. (1975). *Sociobiology: The new synthesis*. Cambridge: Harvard University Press.
- Wilson, E.O. (1978). *On human nature*. Cambridge: Harvard University Press.
- Youniss, J. (1986). Development in reciprocity through friendship. In C. Zahn-Waxler, E.M. Cummings, & R. Iannotti (Eds.), *Altruism and aggression: Biological and social origins*. New York: Cambridge University Press.

2

Resources and Resource Acquisition During Ontogeny

WILLIAM R. CHARLESWORTH

Introduction

Sociobiologists studying humans can expand the significance of their efforts by focusing upon resources and the various behaviors used to acquire them during ontogeny. It is a commonplace observation that individuals have needs for particular kinds of resources and that these needs and the behaviors used to acquire them change over developmental time. What is perhaps not commonly recognized is that variability in access to resources is directly or indirectly responsible for significant variability in individual functioning, development, and reproductive potential. This possibility was recognized by Darwin early in the development of his theory. It became clear to him after reading Malthus that the relationship between resources and individual survival had direct consequences on population size and hence constituted one of the major factors responsible for evolutionary change.

Darwin also recognized that the relationship between resources and differential survival held even when resources were abundant, since it was frequently the case that many individuals would compete for the same resources at the same time. If this is true for animals, one can easily imagine that it is also true for humans, not only in the past but in the present as well. Today there is little reason to challenge Darwin's thinking: everyday observation yields abundant examples of resource competition. Whether it is an infant crying for attention, a preschooler struggling with a sibling over a toy, an adolescent trying to impress a peer, a graduate seeking a job, a scientist writing a grant proposal, or an octogenarian looking for someone to shovel snow, the possibility is always present of failing to acquire what one needs because of the competing needs of someone else. While all needs obviously do not have to be satisfied, a certain proportion of them must be if the individual is to carry out normal life functions.

Situations exist, of course, in which resources are provided by others regardless of the individual's behavior. Parents providing for their chil-

dren is a common example. There are also social situations in which competition for resources is seldom if ever required. Individuals frequently exchange resources with relatives and friends, with no expectation of reciprocation and hence no need to feel they are entering a competitive situation. However, such situations occur less frequently than situations in which acquiring resources is directly contingent upon expectation of reciprocation (which can result in competition) or upon how well the individual actually competes for them. Competition can take many forms, ranging from obvious acts of aggression and intimidation to subtle forms of appeasement, deception, and, as will be argued below, even cooperation.

Given the perduring emphasis upon the social value of cooperation, it is easy to underestimate the prevalence of everyday competition at the individual level for vital resources. Despite the success of most modern societies in controlling environments in order to provide everyone with ample resources, competition is still a major fact of daily life. Competitive struggle is characteristic even of societies possessing sophisticated codes expressly developed to ensure equitable resource distribution. The mentally retarded, chronically ill, the socially different, the low-income aged, those living under racism or military occupation are clearly disadvantaged in competing for resources. This is not only true in societies in which resources are in short supply. Variation in resource distribution is frequently prevalent in societies possessing great resource abundance. Social structures are usually built around well-established dominance hierarchies and bureaucracies whose primary (if not always ostensive) function is to control resource acquisition and distribution.

Given that behavior is heavily implicated in the task of resource acquisition, it is important, then, that sociobiologists studying humans pay attention to the economics of daily living. This means ascertaining empirically what resources are available in particular environments and whether the acquisition behaviors directed toward them actually contribute to successful adaptation and reproduction, as appears to be the case with animals. If behavior makes a difference in adapting to local resource conditions, then we should have a better idea why life histories in humans have such different adaptational and reproductive outcomes and how resources become so unequally distributed among individuals despite societal efforts to ensure otherwise.

In addition to focusing on everyday economics, sociobiologists interested in understanding humans face the additional task of studying individuals over ontogenetic time. Because humans experience widely varying environments and undergo substantial changes in behavior during their lifetime they seldom if ever offer clear, unchanging targets to agents of natural selection. The complexity and indeterminacy in the life history of every human compels caution in

formulating hypotheses about causes responsible for variations in individual adaptation. The only sure way to unravel the complexity of ontogeny and the selection pressures that operate during it is to monitor individual/environment interaction longitudinally. As onerous and time-consuming as such a task may be, there is no more scientifically certain way of applying the power of evolutionary theory towards understanding the functions of human behavior.

Such a task, however, can be lightened by developing a research approach explicitly constructed to resist being overwhelmed by the richness of everyday living (a common fate of those who do observational/longitudinal research). This can be done by concentrating on the elements of individual/environment interaction that appear to be critically related to successful everyday adaptation and hence, by logical extension, to successful reproduction. The model of resources and resource acquisition proposed below is a contribution to such an approach.

Adopting resources and resource-acquisition behavior as organizing principles in studying human behavior and its ontogeny requires at least two distinct efforts—(1) acquainting oneself with existing concepts, methods, and data from human and animal research that bear on resource acquisition and the environmental as well as genetic factors surrounding it, and (2) developing a research model aimed at collecting data on resource acquisition that are relevant to larger issues of adaptation during ontogeny and reproductive success.

Present Approach

While many behaviors appear to have little adaptive consequence for the individual, a significant number are goal-directed acts in which the goal is clearly a resource vital to the individual's health, development, and reproduction. These acts, as well as the resources toward which they are directed, can vary greatly over ontogeny. As is known, for example, from animal imprinting studies, there are periods during ontogeny when the absence or presence of certain stimulus objects (resources) have a significant impact on later development. The same applies (in a different manner, of course) to humans. A classic example of this can be found in infant attachment research, which has demonstrated the negative effects of the absence early in life of stable and supportive caretakers.

What follows is divided into four parts. *Genetic imperatives, resources, needs, and behavior* stresses the importance of recognizing behavior as an evolutionary adaptation that ensures that organisms acquire resources in order to satisfy basic needs. These needs are in the direct

service of genetic imperatives to survive, develop, reproduce, and to achieve ideals. A conceptual model of the relationships between genetic imperatives, resources, needs, and behavior is developed along with a list of dimensions characterizing resources.

Competition for resources develops the argument that individuals form social bonds in order to acquire resources and in the process frequently become enmeshed in competitive relationships that strain these bonds. Since individuals differ in their ability to act effectively in competitive situations they differ as a consequence in their level of adaptation and quality of life. With experience each individual learns increasingly more complex strategies of behavior in order to maintain social bonds and avoid aggression and ostracism. Such strategies not only include overt competitive acts such as physical or verbal aggression and intimidation, but also manipulation, deception, and, contrary to traditional definition, cooperation.

Ontogenesis and resources examines the notion that resources have to be provisioned throughout ontogeny if normal development is to occur and the genetic imperatives are to be obeyed. A model is provided which focuses upon the relationships between behavior, resources, and factors such as level of developmental competence, general aptitudes, and ability that significantly influence the range of opportunity the individual has in satisfying needs. Traditional models of developmental tasks are seen as helpful in identifying needs and the corresponding imperatives at different periods of ontogeny.

A *research model* presents a scheme for identifying (through naturalistic observation) what resources individuals seek, how they go about acquiring them, and how successful they are at it. Emphasis is placed on social situations in which resources are in short supply relative to the demand for them.

Genetic Imperatives, Resources, Needs, and Behavior

It is axiomatic in biology that every living organism is genetically programmed to construct mechanisms that ensure that the organism will maintain its vital functions, grow and develop, and reproduce according to the species-specific program assigned to it (Platt & Reid, 1967; Starr & Taggart, 1984). A major problem, however, with being an organism is that what is needed to stay alive exists in an environment external to the organism. And this environment is seldom obliging. Genetic imperatives equip organisms to deal with this problem. Such equipment consists of at least three kinds of systems: (1) need systems that detect and signal the absence of resources; (2) mechanisms that initiate and control behaviors which, given appropriate stimulus condi-

tions, lead to the satisfaction of these needs; and (3) mechanisms that make possible the alteration of these behaviors in order to allow the organism to adapt to environmental changes.

While organisms are genetically informed to acquire appropriate resources during their lifespan, they are directly dependent upon the proximate events of everyday living to achieve their goals. The factors and events constituting this life process are sketched in Figure 2.1.

The vital process of resource acquisition begins with two preconditions for an organism's existence—that the organism be programmed with genetic imperatives to carry out the major life functions of maintenance, development, reproduction, and (for humans) achievement of ideals, and that the resources necessary to obey these imperatives are present in the environment. Oxygen, for example, is a necessary and environmentally available resource for normal cell functioning.

All organisms are faced during ontogeny with at least two basic kinds of problems—need for resources (because they are absent and hence unavailable), and defense of resources (because they are present but others also seek them). The corresponding tasks of the individual facing these problems are to acquire the absent resource and to retain the already possessed resource. To deal with the task three major kinds of resource-directed action are required: (1) actions aimed at locating the resource, (2) actions aimed at competing with others who also seek the resource, and (3) actions aimed at defending the resource if it is already acquired. In discussions to follow, locating and defending resources will be omitted for space reasons.

Outcomes of resource-directed actions can be positive for the individual in that the resource is acquired and therefore available for use or negative in that the resource is not acquired and the individual is forced to return to the resource absence condition and begin the resource-seeking anew. If the former is the case, the need for the resource is reduced, thereby obeying the genetic imperative by means of the intermediate consequences related to them. The latter, in turn, may have potential phylogenetic consequences.

IMPERATIVES

The term *genetic imperative* is used here to refer to biological laws controlling life through mechanisms that make possible the extraction, transformation, and utilization of energy resources located in the environment. Obedience to these imperatives represents an important evolutionary adaptation characterizing all living forms. Because of the random quality of genetic mutations and random quality of many events occurring during ontogeny every population of organisms contains individuals who vary genotypically and phenotypically in their ability to obey these imperatives. It is upon the phenotypic variation

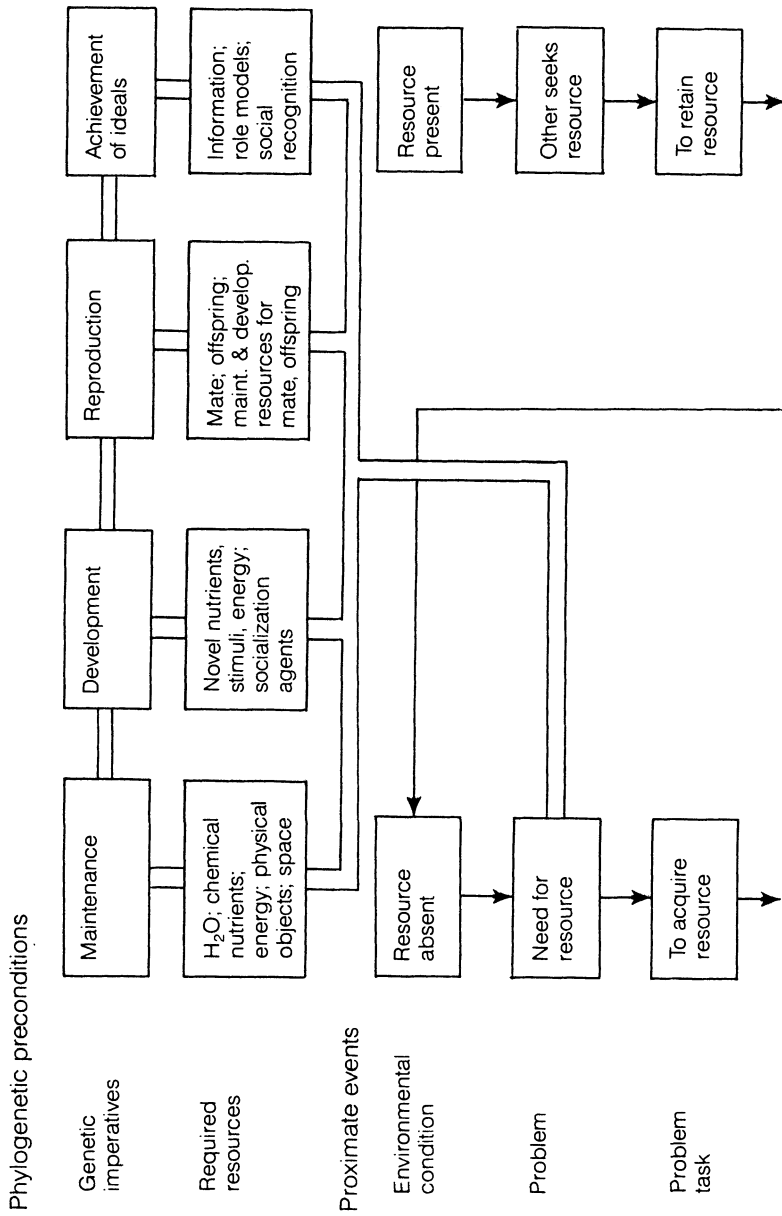
(directly) and correlated genotypic variation (indirectly) that selection pressures operate.

Imperative and *obedience* are used here figuratively to stress that these processes serve as the foundation upon which behavior mechanisms depend for their existence. Furthermore, it is upon the proper operation of these mechanisms that the organism depends for its survival. That behavior can be altered rapidly and frequently in no way diminishes the coerciveness of the biological imperatives. In fact much behavioral alteration that takes place as a result of learning is usually in the service of such imperatives. A major exception to this, of course, can be found in addictive behavior.

The issue of genetic rigidity and behavioral flexibility is a significant feature of the instinct and learning controversy which, hopefully, has been permanently laid to rest by Mayr's (1974) novel concept of "open and closed genetic programs" controlling behavior. The concept is novel because it makes a direct connection between behavioral mechanisms as evolutionary adaptations and the environmental conditions that made such adaptations necessary. Open programs grant the organism flexibility to learn new behaviors to adapt to fluctuations in the physical environment (usually having to do with food resources, which the organism is under the biological imperative to acquire); closed programs, in contrast, confer rigidity to behavior as is the case with much courtship behavior, where it is important that the behavior as well as its targets are unambiguous, stable, and hence highly predictable (because the organism is under the biological imperative to reproduce).

The connection between genetic programs and ecological conditions which Mayr now makes possible to conceptualize has finally become accepted in biology and needs only to be explicated in detail species by species (Gould & Marler, 1987). Both instinct and learning can now get their due recognition. Survival in a constantly changing environment requires both instinct (to motivate the individual to satisfy its needs and thereby obey its imperatives) and learning (to adjust the individual's behavior to meet changes in the environment that threaten satisfaction of such needs). As Ghiselin and Scudo (1986, p. 194) point out, "an animal lacking 'instincts' altogether would be a complete slave of conditioning." Conversely, an animal lacking conditionability altogether would be an environmental casualty long before maturity.

As indicated in Figure 2.1, genetic imperatives can be divided into four major categories: *Maintenance imperatives*, which require that the organism make its daily adaptations by meeting transitory but vital physical needs for water, oxygen, chemical nutrients, etc. and psychological needs requiring various forms of sensory and cognitive stimulation; *Development imperatives* (morphogenesis, differentiation, and integration), which require that the organism move from a state of physical and psychological immaturity to one of maturity mainly through exposure



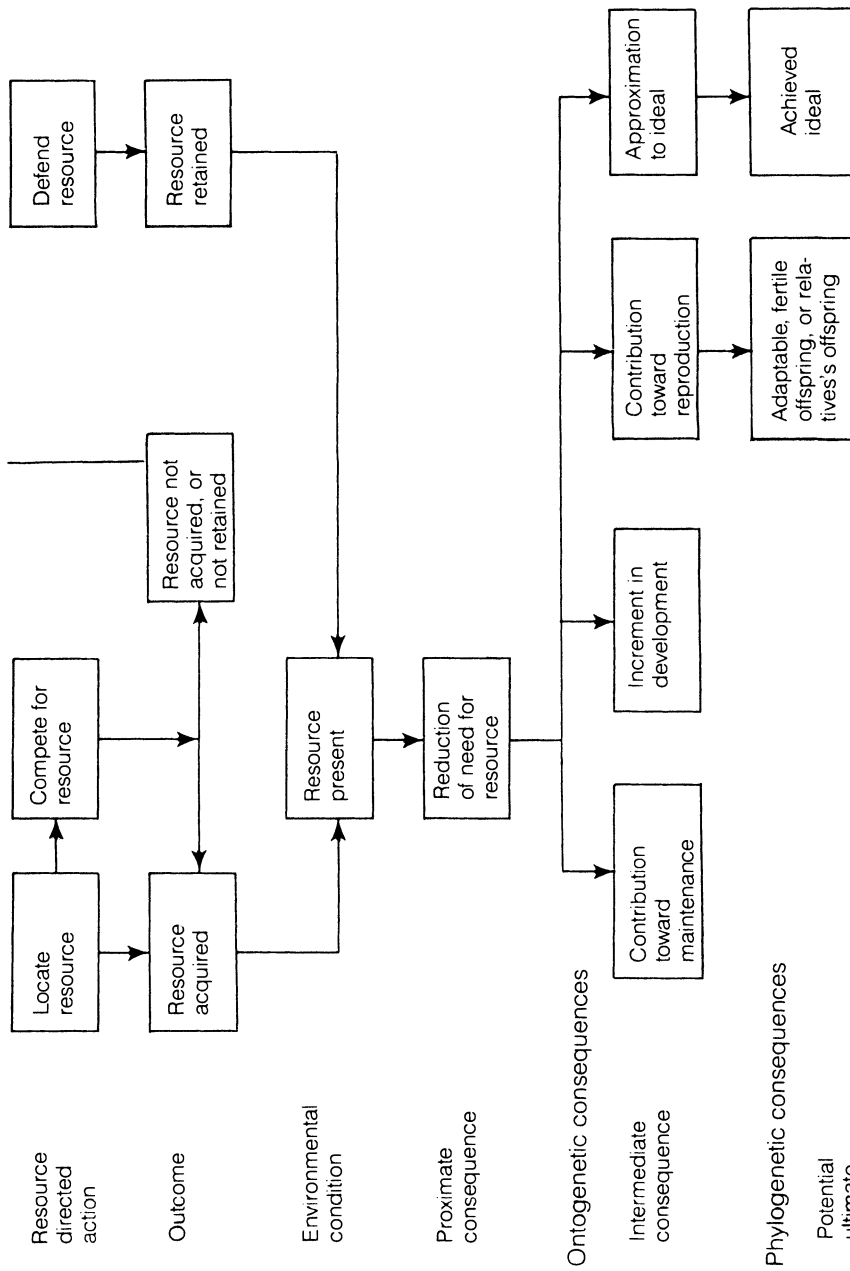


FIGURE 2.1. Imperatives, resources, needs, and action.

to challenges provided by novel energy sources; *Reproduction imperatives*, which ensure that the organism engage in the complex set of social behaviors such as acquiring a mate, practicing good parenting, and caring for kin that result in successful reproduction.

The fourth imperative, *Achievement of ideals* (for want of a better term), appears to be characteristic only of humans. This imperative demands that the individual achieve or adhere to certain moral, ethical, religious, scientific, esthetic, or political standards that may or may not be biologically useful. This imperative can jeopardize the functioning of the three other imperatives through excessive fatigue, poor nutrition, maladaptive social behavior, etc., or it can support them by way of winning social support or improving adaptive skills.

In principle, all four imperatives can conflict with or mutually support one another, thereby having a direct effect on the overall level of the organism's adaptation. As a rule, though, we can expect that selection favors a synchronized coordination of their operations during ontogeny. For example, while the maintenance imperatives are to be obeyed throughout all of ontogeny, many of the developmental ones have to be obeyed before the reproductive imperatives can become operational.

RESOURCES

The word *resource* derives from the Latin *surgere* to rise up, to lift and has come to mean a source of aid, support, supply (that which relieves, helps one to rise again). In modern biology, *resource* refers to a substance or object that serves as a source of energy required for survival, growth and development, and reproduction (Ricklefs, 1979). A site or territory where such substances are located can also be viewed as resources. The term is used to designate an environmental feature of vital significance to the organism.

The position of resources in biological behavioral research is relatively recent. The 1970s seem to be a turning point. In discussing the issues of resources and evolution, Ghiselin (1974) urged biologists to think like ecologists and for behavioral scientists to think like economists. In viewing trends in biology, Wiens (1977) noted that biologists have recently been putting greater emphasis on resource competition in their approach to understanding connections between forms and functions of social organization and local ecological conditions. And Emlen (1980) noted that biologists were coming to view the availability and distribution of resources as good predictors of territorial behavior.

The significance of the concept of resource for helping understand human behavior goes back at least to 1776 in Adam Smith's *Wealth of Nations*, where the science of economics had its first major start. More recently, various disciplines specifically address the connection between resources and human activity—in economics (Samuelson, 1976), in

anthropology (Harris, 1979; Bennett, 1976; Chagnon & Irons, 1979), in the social sciences (Micklin, 1984; Sprout & Sprout, 1965), in psychology (Whiting, 1960; Foa, 1971), and those specifically interested in environmental design and human adaptation (Geist, 1978; Hobbs, 1980; Bryant, 1985).

Specific application of the resource concept to problems concerning human fertility and reciprocation, both critical issues from a sociobiological perspective, have been recently conducted, for example, by Essock-Vitale and McGuire (1980), who show that kin are more likely than nonkin to be recipients of assistance (a social resource) when no reciprocation is expected. Essock-Vitale (1983) also shows that the reproductive success of wealthy Americans exceeds that of the general U.S. population, and, in a similar vein, Essock-Vitale and McGuire (1985) have evidence that financial help, emotional support, and helping out are more likely to be reciprocated by friends than by kin. More recently, in a review of over 100 preindustrial societies, Betzig (1986) reveals that despotism and differential reproduction (powerful men have more descendants than the less powerful) are significantly related in historical times.

Nevertheless, with few exceptions (a major one to be noted below), the concept of resource has traditionally not been a guiding concept for the vast majority of behavioral scientists studying humans. Encyclopedias and dictionaries of psychology or the social sciences tend not to contain the term (Sills, 1968; Corsini, 1984), and when the term is mentioned, it is dealt with very lightly or in terms directly related to animal research (Harre & Lamb, 1983).

Absence of the term *resource* in much of the psychological literature, however, does not imply that some of its referents have not been studied. The concepts of goal, reinforcer, reward, cost/benefit, property, and possession have been standard tools of much learning and social interaction research. Hull (1952), for example, posits *K*, the reinforcing characteristics of a stimulating situation, as playing a critical role in his behavioral equation. Food is seen as a primary reinforcing agent and money (as a means of obtaining food) as a secondary reinforcing agent, both clearly vital resources for humans. In addition, Hull's theory of "value" (an object of great value will elicit vigorous attempts to obtain it) is implicit recognition of the economics underlying learning and behavior. In a more updated treatment, Hinde (1979) provides an insightful discussion of rewards and their role in understanding animal and human relationships. In the latter, as Hinde points out, rewards (or resources) constitute the pivotal concept in social exchange theory. This is the major exception mentioned above which we can turn to now.

In a major review of the literature, Graziano (1984) points out, the concept of resources has been central to various social exchange theories (Foa & Foa, 1980; Homans, 1974; Thibaut & Kelley, 1959). The domi-

nant shared proposition of such theories is that individuals interact whenever it is in their interests to do so, and the goal of their interaction is to satisfy needs they cannot satisfy on their own. The source of satisfaction can be labeled as resources. Such a proposition is obviously at the core of sociobiological thinking; however, the proposition still needs to be hardened operationally for research purposes. Graziano (1984, p.167) notes that exchange theories fail as a rule to specify what it is exactly that is being exchanged in social interactions: "it is extraordinarily difficult to find an exchange theorist who will commit himself or herself to a list of objectively observable commodities or rewards and costs associated with individual persons" (as an exception, Graziano cites Walster, Walster, & Bersheid, 1978).

Despite an operational deficiency in social exchange theory, the concepts that constitute it and the vast amount of data on human behavior obtained from it make the theory prerequisite reading for sociobiologists interested in undertaking research with humans. In doing so, sociobiologists, however, will quickly discover that such research has been almost exclusively centered on exploring proximate mechanisms controlling behavior. The long-term or ultimate significance of such goals as they benefit the individual's health, development, or general adaptation have scarcely been addressed by such research. Nor have the social exchange researchers made any significant attempt to address the exchange process as a resource acquisition process related to processes outside of the test setting or to day-to-day events in natural settings.

Fortunately, a small but informative body of research literature on day-to-day behavior now exists and can be applied to studying resource behavior from a sociobiological perspective while still utilizing concepts from exchange theory. The pioneering field observation research of Barker (1963), Barker and Wright (1971), Gump (1967), and Willems (1973), for example, offers researchers a rich mine of procedures and data to begin studying resources and resource acquisition behavior.

As noted, a resource can be defined as a source of energy located outside of the organism that serves to satisfy the needs generated by the organismic imperatives of survival, development, reproduction, and the achievement of ideals. We could limit the definition to any feature of the environment that contributes to an organism's reproductive success (Barash, 1982). However, a broader definition allows us to include a wide range of outside sources of energy that satisfy needs. Whether such satisfaction is actually related to reproductive success has, of course, to be determined empirically. Also, we do not need to focus only on traditional resources such as food, mates, useful environmental objects, money and space. We can label as resources the more nebulous, but just as vital, goals of behavior such as affection, attention, respect, admiration, public recognition, novel and exciting objects, settings, or situations—things that people seek, work for, and find satisfying.

We can also consider as resources subjects such as alcohol or drugs that can be abused or even persons that can be victimized if they can be identified as goals of instrumental behavior aimed at satisfying emotional or social needs that cannot be satisfied in any other manner. Success or failure in acquiring and using such substances or victims can also be related to various measures of adaptational and reproductive success or failure. We must assume that selection operates under all human conditions.

Defining resources to include anything ranging from physical objects to social contacts and information is not novel. In a pioneering attempt at classification of rewards in interpersonal exchanges, Blau (1964) organized rewards around such dimensions as whether they were spontaneously or calculatedly given, whether they were extrinsic or intrinsic, or complementary. Foa (1971) went further and employed a taxonomy of "interpersonal and economic resources" that include money, goods, services, love, information, and status. In expanding the definition in this manner, however, objective criteria must be used in order to reliably identify the resources in naturalistic settings. In this respect, what is being offered in the present model is the suggestion to establish these criteria by insisting that emphasis be put on behavior and its goals as observed and recorded by an outside observer.

An attempt has been made to list major dimensions of resources which can be applied to particular resources identified in naturalistic studies. This list can be seen in Table 2.1.

It is assumed that all resources can be evaluated in terms of most if not all of these dimensions at some point in an interaction analysis. The shared characteristic of resources is that they are always desired by individuals (in the psychological sense), are frequently but not always required (in the biological sense) to meet genetic imperatives, and are situated outside of the individual. Knowledge of the existence of resources can be obtained for research purposes through direct observation of resource-directed behavior as well as from inferences from other behavior, from spontaneous and elicited verbal behavior, and, of course, through observations of the physical features of the environment itself. The latter have to be continually conducted along with the behavior since the resource dimensions themselves are not independent of the individuals occupying the particular environment under observation.

Let us move down Figure 2.1 to the section on Proximate events having to do with needs.

NEEDS

The phylogenetic preconditions of an individual's existence have been discussed above in terms of organismic imperatives and the resources required to obey them. These preconditions are static and dispositional

TABLE 2.1. Resource dimensions

(1) Type	The substantive nature of sources of energy or stimulation available to the individual
Physical	Water, chemical nutrients, energy sources, physical objects and spaces that maintain life
Social	Individuals or groups of individuals (of the same or different species) that provide visual, tactual, auditory, and verbal stimulation interpretable as attention, affection, recognition, etc.
Informational	Physical objects or individuals that provide stimulation interpretable as familiar or novel information
(2) Quality	The extent to which the resource satisfies the need motivating the behavior to acquire it
(3) Quantity	The amount of resource available at the time it is being sought
(4) Conservability	The extent to which acquiring the resource reduces the environment's store of the resource
(5) Stability	The extent to and manner in which the resource is stable in the environment
(6) Predictability	The extent to which the resource is forthcoming from the environment in a predictable manner
(7) Contingency	The extent to which acquiring the resource is contingent upon the behavior of the individual seeking it
(8) Usability	The manner in which the resource is to be used—consumed immediately or later or employed as a means to obtain another resource
(9) Suitability	The extent to which the resource is suitable for use at the time it is sought
(10) Accessibility	The extent to which the resource is accessible to the individual because of such factors as time, space, obstacles, or the individual's ability to obtain it
(11) Reciprocity	The extent to which the resource can be reciprocated in kind when once acquired
(12) Shareability	The extent to which the resource can be shared when once acquired

in the sense that they are genetically fixed. Ontogenetic conditions, in contrast, are dynamic and eventful because they consist of continually ongoing interactions between genetically fixed individual characteristics and variable environmental and individual characteristics.

Because of uncontrollable environmental factors, resources are frequently absent during ontogeny, hence the individual is continually faced with the problem of acquiring them. The absence of a required resource can be expressed by the concept of need, implying a goal-directed state of desire produced by a lack of the goal. Drive state is used frequently as a substitute for a need that directly motivates behavior. In traditional psychological research a need is usually viewed as a "hypothetical process the occurrence of which is imagined in order to account for certain objective and subjective facts" (Murray, 1938, p. 54).

Initiation of an instrumental behavior suggests the presence of need; persistence of the behavior suggests that the need has not been satisfied; termination of the behavior suggests it has been satisfied.

The content of many needs is predetermined by genetic imperatives and thereby falls under the traditional rubric of primary needs. However, needs are not constrained at birth by genetic determination. Needs can appear at one point in developmental time (sustained sucking during early infancy or prolonged undirected physical movement characterizing toddler play) and then disappear, followed by new needs (babbling and directed physical movements). Such appearances and disappearances can be attributed to processes of physical maturation or to learning (acquiring affections for certain persons, or a taste for dry martinis before dinner).

Experiences with new objects or situations are clearly important in altering or establishing new needs. Hull (1952) maintains that needs in general for a particular object will not develop until the individual has experienced reinforcement by that object. Needs that appear to be learned are referred to in traditional psychological literature as "psychogenic needs," "secondary drives," or "social motives" (Murphy, 1954, Murray, 1938). Exactly what the determining factors are of such needs is frequently difficult to ascertain. It is conceivable that, as Hull argues, strong reinforcement for certain behaviors can alter primary needs or lead to the acquisition of new needs through simple association. Additions to new substances may fit this category. In animal research the distinction between primary and secondary aspects of motivation is relevant here (McFarland, 1982). While the act of drinking is motivated by the primary drive of thirst, caused by the need for water by dehydrated tissues, it is also affected and motivated by such factors as the palatability of the water, time since last drinking or feeding, outside temperature, etc., all of which are directly related to prior experience and variable environmental conditions. Since such conditions and events clearly affect future motivations, we cannot attribute the latter to maturational changes.

It is easy to imagine how intertwined primary and secondary motives can become over the course of human development. The ontogeny of dominance behavior, for example, must involve a complex interweaving of genetic tendencies for extroversion or assertiveness and high activity level and early experiences with dominants and subordinates. The task of the present approach is not to disentangle these variables but to describe the various individual/environment interactions that characterize dominant and nondominant individuals in terms of their comparative efficacy in acquiring resources. That the approach is developmental means special cognizance must be taken of different needs and hence different resources required at various chronological

ages. It should be noted that, though viewed only as hypothetical constructs, needs hold an important position in the present model because they constitute a logically necessary connection between the individual and phylogenetic preconditions.

RESOURCE-DIRECTED BEHAVIOR

The concept in psychology of goal-directed or purposive behavior has a long history dating back at least to the early part of this century (Silver, 1985) and finding current representation in cybernetic models such as that by Miller, Galanter, and Pribram (1960). In developmental psychology, in particular, the concept has been well represented as a laboratory phenomenon by Lewin (1935) as well as an object of field research by Barker and Wright (1971). Those working with the concept shared the basic definition that the behavior had a preestablished goal as part of the program governing the behavior, that there existed means to monitor when the goal is reached or not, and that when reached, the behavior involved in reaching it terminates. If the goal was not reached, the behavior was repeated (persistence is an important indicator of goal-directedness) or replaced by another behavior directed at the same goal.

More recently, the basic concept of goal-directed behavior has been expanded into new, sophisticated models that help clarify our thinking about such behavior in general as well as identify its basic features (von Cranach & Harre, 1982; Frese & Sabini, 1985). The renewed interest in such behavior and the fruitfulness of these models in generating research attest to the importance of including the concept of goal-directed behavior in an economic model of human behavior.

As can be seen in Figure 2.1, there are two major classes of resource-directed action implicated in the problem situation of a resource need (defense of a resource is a different matter). First, the individual must locate the resource if it is not immediately available. The specific behaviors involved in this act may include perceptual acts (visually attending to particular stimuli), locomotor acts (moving to other areas or around obstacles), social acts (asking others questions), and cognitive acts (checking information sources). Such acts are means-ends behaviors that may or may not implicate environmental objects in the attempt to locate the resource. Such acts can lead directly to the resource and the individual can immediately acquire it. However, as is frequently the case, others either are also seeking the same resource or are already in possession of it.

After locating the resource, the individual must frequently compete against others for it. This is the second major class of resource-directed actions when there is a need for a resource. As noted above, competing for resources is a major task of all organisms. In the present model, an act of competition is defined as any action that is directed toward a

resource also sought by others or already in their possession. This definition is intentionally broad to include behaviors that have traditionally been associated with competition—aggression, threat, deception, manipulation, etc.—as well as behaviors that have not been associated with such a tradition, for example, cooperation. As will be discussed in more detail below, social animals are compelled to cooperate in many different ways in order to satisfy their needs. This does not mean that competition is totally absent. Because resources are never adequate to satisfy all needs of all individuals, competition is potentially always present, even when cooperation is most evident.

A third class of resource-directed actions are engaged in when the problem task is to retain a resource; such actions involve defending the resource. This class of action also includes many different kinds of behavior—resisting, concealing the resource, avoiding or ignoring the individual seeking the resource, or counterattacking if necessary. There are many ways of retaining resources already in one's possession.

The success or failure of the resource-directed actions is determined by whether the resource is present (acquired or successfully defended) or absent (not acquired or not successfully defended). The proximate consequence of its presence is reduction of the need that motivated it; the proximate consequence of its absence is the maintenance of the need that motivated it. In the former instance, after the resource is assimilated, experienced, consumed, or utilized, other behaviors are undertaken. In the latter instance, four possibilities face the organism—the original resource-directed behavior is repeated, an alternative behavior is undertaken, a substitute resource is sought, or resource-directed action is postponed, if possible, until a later time.

Whatever the outcome, the resource need-action-outcome process has consequences—body homeostasis is maintained or not; physical or mental development is furthered or retarded; a contribution is made or not made toward reproduction; or an ideal is or is not further approximated. In all instances the process and its outcome is no trivial activity, no matter how microscopic the economic interchange may appear in terms of behavior, resource, or time spent. The process of meeting the imperatives is continuous until death—the individual/environment interaction over ontogeny involves a constant flow of resources from the latter to the former.

The process as depicted here can be conceived as covering many different timespans and many different levels of complexity. It applies to such a simple event as asking someone to turn down the radio because one needs silence or to such a complex set of drawn-out events as working one's way through college because one wants an interesting job. Between recognition of the need and the resource goal there may be many intermediate steps all of which themselves may also involve resources. There may also be delays in reaching the resource, alternative actions to

acquire it, substitutes for the resource, and replacement of developmentally early needs for developmentally more mature ones. There may be complex social interactions involved which give no hint as to their contribution to some ultimate function. In all of this the genetic imperatives must sooner or later be obeyed. When the imperatives are consistently thwarted and not obeyed, physical and psychological problems accumulate. If no compensatory actions are undertaken, the individual is at risk for ill health, developmental retardation, reproductive failure, or loss of ideal achievement.

It should be kept in mind that the process of resource-directed action is complicated both positively and negatively by the fact that humans with similar as well as conflicting needs are intimately connected to one another throughout ontogeny. This complication is one of the main sources of the sociobiologist's problems. It is to those we now turn.

Competition for Resources

The problem of ontogeny is fundamentally the same for all individuals. Each must seek resources in order to survive and develop. The task, however, is often made difficult because others also seek the same resource or already possess a resource and are reluctant to share it. Early in ontogeny the task is solved by the individual's parents, who usually supply resources noncontingently. However, with age obtaining resources becomes almost exclusively the task of the individual, who has to learn a vast array of various resource-acquisition behaviors and when to employ them. With humans the task has virtually always a social element to it.

Evolutionary biologists are familiar with the advantages and disadvantages of being a social species. Species members benefit from collective engagement in predator defense, foraging, habitat exploitation, and transmission of adaptive information. The advantages of socially coordinated action appears to offset such disadvantages of group living as rapid spreading of parasites and disease and higher incidence of social conflict. The latter poses perhaps the greatest problem because it is potentially always present and usually requires relatively high-level skills to avoid or terminate when once started. The problem becomes especially acute when an unskilled individual requires a resource from one who is skilled but uncooperative or when some individuals cheat others by failing to reciprocate resources when they are expected.

Historically, much discussion of social conflict has centered on the question of whether aggressive behavior characterizing conflict is learned or innate. This question, however, cannot be answered as posed in this form for the simple reason that behavior is an event and events

cannot be said to be innate or learned. One can claim, though, that the *disposition* to behave in an aggressive way is innate (or learned) if one has adequate evidence on the genetics as well as ontogeny of aggression, a very unlikely situation since such evidence is obviously very difficult to obtain.

A more interesting (and answerable) question concerning aggression relevant for the present approach was addressed decades ago by Craig (1921). Dismissing the innate/learned dichotomy as unproductive, Craig focused instead on proximate factors associated with aggression. In doing so he raised an extremely important methodological as well as substantive point that goes beyond proximate factors: "To understand why an animal fights, we must watch its fighting behavior, and also study the relation of its fighting to its other behavior, to its life history—in short, to its whole economy" (p. 265). This one sentence tells the whole story. If it had been taken seriously by psychologists the science of human (as well as animal) aggression or conflict would be very different today.

In the same essay Craig also noted that "we must turn away from the theories of evolution which are highly speculative—and examine at first hand the facts as to fighting among animals" (p. 265). At the time, such advice was badly needed because Darwin proponents were engaged in much more speculation than empirical research. Today things are different but not totally. Speculations about the evolutionary nature of behavior, while generally more subdued and sophisticated, frequently are still not adequately phrased to be tested empirically and consequently are often useless, misleading, or potentially dangerous (Kitcher, 1985). However, not all post-Darwinian theorizing has been useless or unscholarly. Evolutionary models of the origins and functions of behavior have been emerging in interesting and not totally untestable forms (Maynard Smith, 1979; Williams, 1966, 1975; Hamilton, 1964; Trivers, 1971, 1972; Alexander, 1974, 1975; Barash, 1976; Daly & Wilson, 1983). Also, as animal research is showing, the collection of "facts" Craig felt were so vital to test speculation is currently being carried out at a relatively rapid rate. The rate for human research is slower and may be due to the fact that the conceptualizing necessary for connecting what we know about humans from nonevolutionary theorizing to current evolutionary thinking has been very recent. The pioneering efforts of Barkow and Burley (1980), Hill (1984), Weigel and Weigel (1987), MacDonald (1984), Rushton et al. (1986), and Rushton, Russell, and Wells (1984) are just beginning to have significant effects on reorganizing our thinking.

Before this effect is exploited for purposes of generating new research, it is important, nevertheless, to be aware of the work of those in the traditional human sciences that bears on issues of utility to sociobiologists. Let us now turn to some of this work.

HUMAN RESEARCH

A good part of the research literature on human social behavior focuses upon such topics as public opinion, group dynamics, social comparisons and social norms, conformity to group pressure, attitude change, cognitive dissonance, prejudice, and interpersonal perception (see Allport, 1985). These topics are primarily psychological rather than behavioral in nature and hence have only indirect relevance for sociobiology. A small but substantial portion of this literature, however, is directed toward examining the functions of social behavior in small groups. Pioneering conceptual analyses of social groups and behavior, Parsons and Shils (1951) and Parsons and Smelser (1956) addressed the utility of social behavior in meeting the needs of adaptation. Influenced heavily by economists, Parsons not only provided a theory of goal-directed action aimed at directly serving adaptation but also a theory of the social structures that support such action. His concepts range from complex social organizations, through the functional imperatives that require such organizations, to personality and its socialization which in turn serve such imperatives. Sociobiologists serious about adapting evolutionary theory to the mechanisms governing human social group will have to deal at some point with Parson's notions.

A second portion of the literature on human social behavior relevant to sociobiological theorizing exists, as noted above, under the heading of "social exchange theory," a theory primarily directed toward the analysis of social interactions in terms of the consequences for the various actors. As leading proponents of this theory, Thibaut and Kelley (1959) argue that all valued commodities and events can be reduced to a single cost/benefit or reward outcome to the participants in social interactions. Homans (1961), similarly, argues that social exchanges can be fruitfully viewed as those in which individuals reward and punish each other.

The general significance of this feature of social exchange theory was also anticipated by Hull (1952), in Theorem 133 of his general learning theory. The theorem states: "Every voluntary social interaction, in order to be repeated consistently, must result in a substantial reinforcement to the activity of each party to the transaction" (p. 337). For Hull, reinforcement was connected with drive reduction, a point that bears directly upon the present approach since reinforcement serves as the main proximate mechanism governing resource-directed behavior.

BIOLOGICAL THEORY

Social behavior constitutes a significant portion of behavioral research in biology as it does in psychology. Social behavior also stimulated the construction of taxonomies of animal social interactions that can be usefully applied to studying humans. Odum (1983) provides a taxonomy of

nine basic population interactions between A (a large, strong, high-status individual) and B (a small, weak, low-status individual) in which hypothetical gains and losses of each interaction are calculated as a function of the type of interaction. For example, in a "mutualistic" interaction, both A and B gain from the interaction, whereas in an "antagonistic" interaction both lose. In a "predatory" interaction A gains and B loses, whereas the reverse is true for a "parasitic" interaction. Such a taxonomy is very useful since it not only specifies the various kinds of interactions that potentially can occur but also specifies the outcomes that can occur as a result of such interactions when two or more animals seek the same resource but differ in ability, a phenomenon very common in the vast majority of social interactions.

General taxonomies can be used best to organize research aimed at dealing with questions directly derived from theory. One such major question derived from evolutionary theory focuses on the costs and benefits of selfish versus altruistic behavior. Since such behavior involves resources broadly defined, it is crucial to address issues surrounding such behavior in the present context.

ALTRUISM AND SELFISHNESS

One of the central problems that faced Darwin was how it was possible for an individual both to act selfishly (by satisfying personal needs through group membership) and still contribute selflessly (at personal cost) to the welfare of other group members. By Darwin's definition, altruistic individuals are those that reduce their own reproductive potential by contributing to the reproductive potential or success of others. Since, by this definition, altruists on the average leave fewer progeny than nonaltruists, any genetic tendency that predisposed one toward learning altruistic behavior would consequently be eliminated from the gene pool. Hence, over successive generations, genes predisposing one to learn altruistic behavior would diminish in frequency in the gene pool and altruism would ultimately cease to exist. That altruism did exist and was widespread in many species confronted Darwin with a serious problem.

At least two solutions to this problem have been proposed—kinship theory and the concept of reciprocal altruism. In presenting his kinship theory Hamilton (1964) points out that altruistic behavior usually occurs between individuals who are genetically related. An altruist's genes, therefore, would persist in subsequent generations despite the fact that by giving help to relatives the altruist sacrifices having offspring. In Trivers's (1971) theory of reciprocal altruism altruistic acts for various reasons induce in the beneficiary a tendency to return the act, that is, provide similar or equal benefits to the altruist. Both solutions, in effect, support the notion that animals are programmed genetically

by evolution to act solely in their own interests. Even what appears to be self-sacrificing behavior may, in fact, be genetically selfish. Both solutions focus primarily on the consequences of behavior rather than on their actual nature, and this may be the crucial distinction that sets off the evolutionary approach from most approaches in the social sciences. This point can be expanded by addressing the issue of cooperative and competitive behavior.

COOPERATION VERSUS COMPETITION

Both cooperative and competitive behavior can be observed with great frequency in humans. Both also vary considerably between and within individuals. The central question asked by evolutionary biologists of such behaviors is the extent to which they enhance or diminish the extent of the individual's reproductive potential. An even more basic question, however, has to do with the definition of both terms and their theoretical status. There is clearly no consensus on either. As Wilson (1975) points out, a theory of competition is of only recent concern in evolutionary ecology. The same can be said for cooperation.

In addressing this issue, Emlen (1973) notes that definitions of competition vary considerably across scientists. Types of competition include "active interspecific competition" such as fighting for and defending territories, "passive competition" in which one species more efficiently exploits a resource than another species, "scramble competition" in which the members of two species do not interact but exploit resources differentially (for example, getting to a resource early and exhausting it before others get to it), and "contest competition" which involves individuals interacting in various ways, hostile or otherwise. These forms of competition contain at least three common elements—an active demand on the part of individuals for a common resource (Wilson, 1985), the competitive behavior itself, and the consequences of the behavior which differentially affects the level of the participants' adaptation (Ghiselin, 1974).

Resources that animals compete for range from territory and food to mates and children. Consequently, the competition behaviors themselves can be extremely diverse; they can also vary across similar ecological conditions as well as within individuals. Furthermore, as noted in the beginning of this chapter, competition is most intense between individuals living in the same social group who have similar needs. Nevertheless, despite characteristics which make competition an important behavioral phenomenon, as Emlen points out, proving that competition takes place in any given natural situation is still a difficult task. This is a critical point that has methodological implications for determining whether resources actually are in short supply or not and the extent to which organisms need to compete for them.

The concept of cooperation appears to be less developed than competition in the sociobiological literature per se (e.g., Starr & Taggart, 1984; Wilson, 1975), whereas it appears to be as developed as competition in the animal literature. This difference may be partly due to definitional problems as well as to relative differences in frequency of occurrence of both kinds of acts. While cooperation can be seen as synonymous with altruism or as a special case of it, it can also be viewed as a "much more prevalent form of aid-giving" than altruistic acts which benefit all participants, not only one participant at the cost of another (Wittenberger, 1981). Mutual benefits of cooperation may include improved defense against predators, enhanced foraging efficiency, and better parasite control through allogrooming. Such a view in effect clearly sets cooperative behavior off from altruism since all individuals are seen as benefitting from cooperating. However, it is possible that such benefits are not equally distributed over the cooperating individuals, thus raising the question of whether competition is actually inherent in cooperative interactions. Before pursuing this question, let us first look at how social psychologists generally view cooperation.

In the human research literature competition and cooperation tend to be viewed by many writers as opposites or at least in conflict with each other (May & Doob, 1937; Mead, 1937; Seymour, 1981). To complicate matters, some researchers view cooperation as a form of altruism directly opposed in its form and function to aggression and without, apparently, any significant relationship to competition (Zahn-Waxler, Cummings, & Ianotti, 1986). Still others conceptualize cooperation as a form of prosocial behavior in contrast to antisocial behavior without addressing the question of the social/cultural relativity of the functions of both classes of behavior. There is also a strong tendency to view cooperation as a more acceptable form of social interaction or problem-solving strategy than competition and a form, moreover, which can be trained into children as a means of abolishing competition (Johnson & Johnson, 1974).

In short, there are no unanimous definitions of cooperation and competition or agreement on the status of their empirical referents in conceptual schemes of human social behavior. One reason for this seems to be that such terms as *cooperation*, *altruism*, and *selfishness* are frequently labels for motives which have no status other than as inferences derived from certain forms of behavior. For example, there is current concern about an overemphasis on egoistic as contrasted with nonegoistic motives surrounding social problems (Lynn & Oldenquist, 1986). Helping behavior is uncritically viewed as reflecting nonegoistic desires or altruistic motives. The consequences of helping behavior, however, are just as important as the form of the behavior itself in assigning any particular status to the behavior. It is conceivable, for example, that an individual helping another may benefit greatly from it and therefore

will persist in the behavior for primarily or exclusively egoistic rather than for nonegoistic reasons. A related point can be made for the terms *prosocial* and *antisocial* behavior. While an aggressive act can be seen as antisocial from one group's perspective, from another group's perspective the same act can be seen as prosocial. Homicide in warfare can be seen from perspectives diametrically opposed to one another.

DOMINANCE

The concepts of dominance and submission also play a significant role in organizing various aspects of social behavior (Wilson, 1975). Both concepts are usually employed to describe relationships involving conflict between individuals of unequal ability. In the animal literature, connections are usually made between dominance hierarchy status and access to resources (Alcock, 1979; Wittenberger, 1981). These connections are much less pronounced in the human literature. In general, the literature tends to concentrate on the nature of dominance behaviors, the role of dominance in social groups and individual relationships (Omark, Strayer, & Freedman, 1980). With few exceptions (Weisfeld, 1980) most studies of dominance in children make little or no references to resources either in their theoretical treatment of dominance behavior or in their description of the behaviors involved in dominance interactions. When resources are mentioned, they usually involve objects or spatial locations contested by two or more children.

With adults the goals of dominant behavior, while frequently not explicit, constitute a significant part of the reason underlying certain behaviors judged as dominant or not. Buss and Craik (1980), for example, generated a list of 15 dominant acts (based on ratings): they included issuing orders, taking charge, assigning roles, demanding action, persuading or forbidding someone to do something. All 15 involved the behaviors of others (defined in the present scheme as social resources) as means, for the most part, of gaining resources. As Buss and Craik point out, while such acts are often "topographically dissimilar," they reflect the common disposition raters judge as dominance.

Analogously, one can view all acts, regardless of topography, as constituting competitive acts when the goal of such acts is resources. For example, a person judged as friendly and cooperative may actually acquire more resources than a person judged as unfriendly and demanding. Winning in a competitive situation is usually more beneficial in the long run than displaying socially acceptable but individually ineffective behavior. One could claim that the best combination is to display individually effective behavior which is simultaneously socially acceptable. A dominant individual who maintains group stability and serves as a group model and leader may still have access to more resources than group members lower in the group hierarchy.

Categorizing behavior by its goals and outcomes rather than its topography creates particular problems but it does allow researchers to determine better the adaptive function of the behavior for the individual. Furthermore, such categorization may be a much more parsimonious way of describing and understanding individual/environment interactions than focusing on the topography of behaviors, which in humans can be enormously variegated. The problem of using goals as the basis for classifying social interactions is in being able to locate the goals objectively. This problem will be discussed in more detail below.

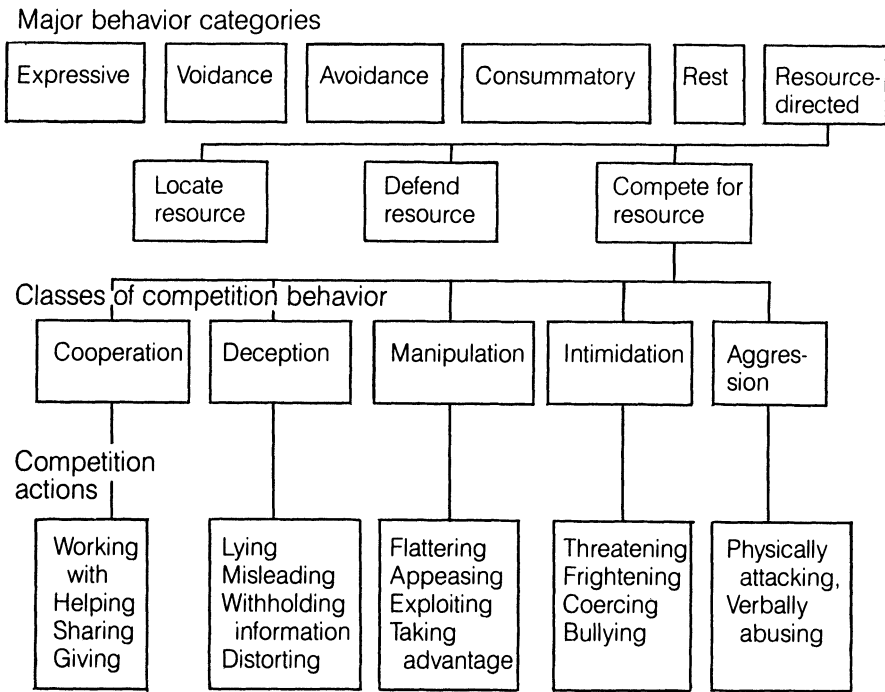
COOPERATION AS COMPETITION

One way of cutting through the morass of definitional differences is to operate on the assumption already noted that an organism's main task is to extract resources from its environment and that any behavior strategy that succeeds in achieving this will be learned and persisted in as long as it is successful. Need states brought on by resource insufficiency serve as the signal for putting such strategies into operation.

Competition can be defined, then, as a situation which occurs whenever an individual needs a resource also needed by another individual or seeks a resource already in the possession of another individual reluctant to share or surrender it. In such a situation the individual can employ a variety of behaviors to acquire the resource, including cooperative behaviors. This point may seem counterintuitive and needs to be developed.

In an earlier paper, Charlesworth (1982) argued that there were at least five major classes of resource-directed actions that could be recruited to serve in competition situations: (1) aggression, physical or verbal; (2) intimidation, physical (gestural, facial, etc.) or verbal; (3) manipulation (flattering, appeasing, etc.); (4) deception (lying, misleading, withholding information); and (5) cooperation (working with others, helping, sharing, and giving). In Figure 2.2, we can see these five classes subsumed under the behavior category "Compete for resource." Deception, manipulation, intimidation, and aggression can be recognized as traditional ways of competing. Cooperation is usually defined, however, as the opposite of competing, especially when we refer to such behavior as "working with," "helping," "sharing," and "giving." But a close look at the situations in which such alleged cooperation takes place reveals that this may not necessarily be true. There are at least two very common life situations traditionally labeled as cooperative which, nevertheless have a strong, if not always obvious, competitive element in them.

One such situation consists of individual A cooperating with individual B to acquire a resource also sought by individual C. Due to the superior advantage of two individuals coordinating their activities, the resource is acquired by A and B and consequently lost by C. Fre-



Note: Some expressive behaviors (smiling, acting embarrassed or surprised) can be brought under instrumental control and used as resource-directed behavior. Avoidance behaviors (ignoring, leaving the area) are frequently used as passive defense of resources. Consummatory behaviors (eating, touching, talking, looking at) are engaged in after the resource has been acquired. Simulated rest behaviors can be used as passive defense of resources (pretending to be asleep or fatigued).

Defending resources involves many actions similar to those used in competing for resources, but are of a more reactive nature (resisting, counter-attacking); defending also includes actively concealing and avoiding.

Sharing and giving, as common cooperation behaviors, are the basic constituents of reciprocation or exchange which may not reveal their competitive nature until reciprocity is uncertain or the resources involved become scarce.

FIGURE 2.2. Taxonomy of resource-directed behavior in competition situations.

quently A and B are totally unaware that C is being deprived of the resource, or if they are aware they show no signs of it. There are numerous daily examples of this. For example, technically advanced countries, even if unfriendly to each other, frequently engage in forms of cooperation that allow them to acquire resources that cannot be acquired by less technically advanced countries. Such cooperation clearly advances the former even further over the latter.

The second form of cooperation that involves competition involves A and B coordinating their activities in order to acquire a resource unobtainable by any other means. The problem with such cooperation is that the contributions of A and B to the cooperative enterprise are very frequently unequal relative to the amount of resource each individual acquires. This happens frequently in pair bonds, families, research teams, or political parties and contributes substantially to their instability. When certain members in the group discover that they are contributing more to the cooperative effort than other members, cheating of some form or other is suspected and conflict invariably results.

Cheating while cooperating apparently occurs not only in humans. In his discussion of the position of cooperation in evolutionary theory, Trivers (1985) reports cheating (as defined below) in lions. He cites, as an example, the division of labor in lion hunts, where males undertake the task of driving prey downwind into an area in which females lie waiting. Selecting the prey out of a thundering herd and killing it is the task of the females, clearly a more difficult and dangerous task than that of the males. Yet, when the males rejoin the pride they tend to take a greater share of kill than the females. In this example the cooperative nature of the hunt helps all members of the pride, but there is a clear competitive element when we look at what each individual contributes to the hunt. This element also becomes apparent when we consider those lions not in the hunt. They, too, like the females are at a competitive disadvantage but of a different kind.

Unequal cost/benefit ratios due to cheating can be found in many other such cooperative enterprises in animals as well as humans. But even if cheating does occur during cooperation, cooperation is still a highly preferred competition strategy. As Crook (1971) points out, animals may engage in cooperation as a "subterfuge" to gain rank (and resources) because it is less disruptive than aggression, and fits into existing group structures. Given this, we should not be surprised, then, to find cooperation employed in many daily situations only to be terminated (temporarily or permanently) because of the discovery of cheating and the resulting inequities. "Pure" cooperation can only be maintained by constant monitoring of the individual cost/benefit ratios that result from it.

Note that the main focus of the present approach to the problem of cooperation and competition is not only on the kind of behavior that is involved, but upon the resources sought and how equitably they are distributed between competing individuals relative to their availability. Taking this approach will account for the causes of social conflict more satisfactorily than arguing that aggressive behavior is an instinctive evolutionary adaptation to resource insufficiency, or a learned cultural trait acquired as a result of reinforcement or imitation in conditions of frustration.

It is possible to view competition as a superordinate phenomenon that subsumes a number of different behaviors employed as conditional strategies to ensure that resources are acquired or retained. Hypothetical combinations of all five classes of behavior can then be made to account for a wide range of resource-related social interactions. Such interactions can be classified as to the nature of the relationships between the individuals involved in them (relatives, friends, enemies, etc.). The combinations and the individual relationships themselves can then be combined. Figure 2.3 serves as an illustration of this. In this illustration relatives are more inclined to engage in cooperative behaviors while enemies tend to engage in intimidation and aggression behaviors. Friends and neighbors and strangers range somewhere in between, mixing cooperation with deception and manipulation and occasional intimidation.

From a cultural point of view, we can imagine that an ideal combination would be mostly cooperation with a bit of deception and manipulation added. In actuality, though, the case could be made that much of human interaction actually falls below the culturally ideal line and involves a relatively high frequency of deception and manipulation often combined with a moderate frequency of cooperation. Unadulterated intimidation and aggression can be viewed as culturally acceptable if directed solely at enemies.

Resource availability is also relevant for determining which strategies are appropriate. Under conditions of great abundance, cooperation is ideal as well as practical—everyone's needs are satisfied and everyone feels satisfied. When resources are very scarce, the strategy, in contrast, shifts to aggression and intimidation.

When we take individual risk into account we find that risk is very low when individuals cooperate and there are very abundant resources and very high when resources are very scarce and the individuals engage in intimidation and aggression. In short, we expect that competition strategies shift according to various factors, but the shifts seldom, if ever, oppose the genetic imperatives controlling the individual's behavior. When opposition occurs and becomes a standard mode of operation, we can assume that the individual is at serious risk.

Ontogeny and Resources

Up to this point we have sketched a conceptual basis for resources and the behaviors employed to acquire them. This basis can be more concretely operationalized for research purposes. Before turning to this, however, the issue of ontogeny has to be dealt with if we wish to apply sociobiology effectively to understanding human behavior.

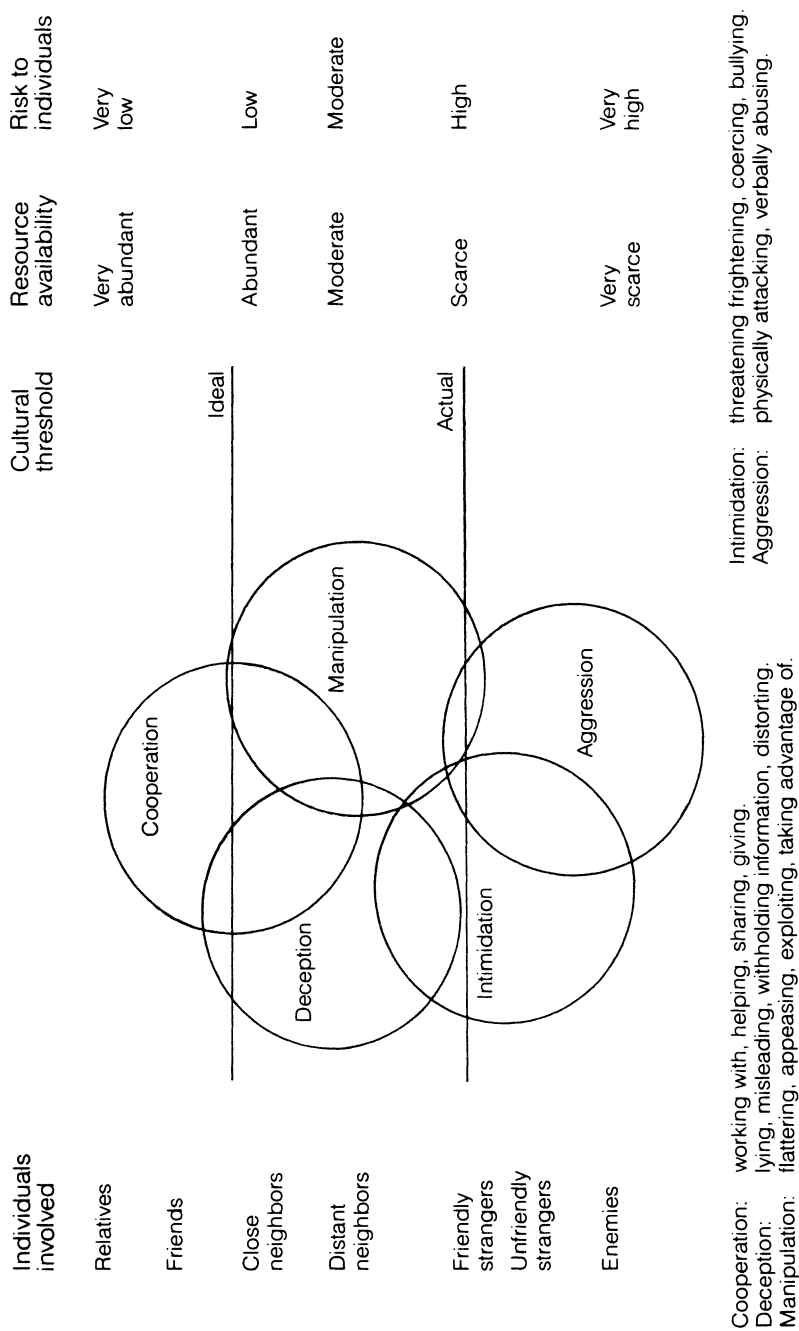


FIGURE 2.3. Hypothetical combinations of major classes of resource-directed actions used in competition situations—when a resource is sought by two or more individuals.

ONTOGENY

In broad terms ontogeny refers to the life history of an individual and the pattern of irreversible changes that take place between the time the zygote is formed and the individual dies. Changes are usually described in terms of increased size, differentiation, and organization of both structure and function. Globally, such changes can be viewed as movement from immaturity to maturity, from a stage of dependency on an older generation, during which size increases and adaptive skills are developed, to a stage of adaptive autonomy and preparation for reproductive activity, and finally to a reproductive phase, during which the individual attracts a mate, produces and cares for offspring, while simultaneously acquiring sufficient resources for self and family.

From a biological point of view ontogeny follows a species-characteristic trajectory that follows instructions genetically programmed into each intact individual's genotype. It is important in sexually reproducing species that ontogenetic changes are more or less lawful across species members for purposes of productive coordination of behavior. Species members of a particular age cohort would have problems coordinating their reproductive behavior if individual ontogenies varied in idiosyncratic ways.

ONTOGENY AND ECOLOGY

Why members of a particular species should begin life as immature as a human and take up valuable reproductive time becoming mature has been a challenging problem for evolutionary biologists (Gould, 1977). One possible value of delayed reproduction is an extended period of free time for learning the features characterizing unpredictable ecological conditions. Population ecologists have helped address this problem with the concepts of K and r reproductive strategies. Animals with the K strategy are characterized as having relatively long periods of early immaturity during which learning takes place. This period is followed by an intense period of competition for resources and mates. The net effect is low fecundity resulting in populations at or near the environment's carrying capacity. Animals with the r strategy, in contrast, have relatively short prereproductive histories, relatively little competition, high fecundity resulting in populations below environmental carrying capacity. K strategists appear to evolve in response to stable, predictable environments, and r strategists in response to unstable, unpredictable environments. Such distinctions are significant since they help establish links between ontogenesis and environmental conditions, a link which appears to be an intricately formed, nonrandom relationship reflecting the evolutionary history of each species' adaptation to local ecological conditions.

The possibility that such a link exists for humans has important implications for studying human ontogeny. There is no extant theory of human development that attempts to view ontogeny as functionally connected by evolutionary processes to specific, nonrandom changes in ecological conditions. As will be seen below, there are developmental life task theories that attempt to link phenotypic changes in behavior to maturational changes and culturally established norms of age-appropriate behavior. These theories are valuable first steps towards a theory linking developmental changes in behavior to specific ecological conditions that demand changes (as tasks would) as well as support them by provisioning the individual with supportive resources.

ONTOGENY AND SOCIALIZATION

According to sociobiologists, individuals are programmed to produce offspring and to invest resources in them (Trivers, 1972, 1974). This activity involves acquiring sufficient appropriate resources as well as engaging in the appropriate behaviors to ensure that offspring acquire these resources in sufficient quantities at appropriate times. Supplying the newborn with nutrients, protection, temperature control, affection, various forms of visual, auditory, and tactile stimulation, etc. are important investment activities.

At later ages, the child, however, requires information on how to acquire resources rather than resources themselves. Such information is transmitted by the process traditionally known as socialization. Without it, all children, regardless of culture, would fail to satisfy developmentally more advanced needs. Furthermore, without such information children would not learn how to acquire resources on their own or how to resist disruptive resource acquisition behavior by others. The child needs to learn from experience with others how to adapt to a specific environment, one for which the child was not prepared by phylogenetic adaptations.

Under normal conditions, the child learns how to adapt to environmental challenges through operant and classical conditioning and observational learning, all of which usually occur in the presence (and as a result) of the behavior of parents, sibs, relatives, and friends. In middle childhood more institutionally supported learning opportunities are provided by schools, clubs, organizations, etc. Unofficial or less formal learning opportunities are provided by peer groups, local individuals, and the media.

The main goal of socialization is to ensure the child's later adaptation and reproductive success. How this success is perceived and defined shapes the content of the child's socialization. Appropriate personal habits, good school performance, and social skills are seen as important goals which may require very different behavior strategies. Personal

habits require caring for the body, being meticulous in hygienic matters, etc. School performance requires paying attention to and carrying out teacher's instructions, etc. Social skills require learning to pay attention, listen to others, helping them, and defending oneself against them.

It is in social situations mostly that the child learns how to compete for resources. Since the child is in a relatively rapid period of developmental change, many skills have to be learned as well as unlearned (or at least not employed). Early in life, emotional behavior (crying, pouting, whining) may be effective in getting one's way most of the time with most persons. With age, however, such behaviors become less successful. Initially such behaviors are most probably not under voluntary control and cannot be considered resource-directed. With age, though, they can come under voluntary control and be used when other behaviors fail (adults who can cry instrumentally may be very successful in acquiring or defending resources). Aggressive behaviors usually appear early, but given their socially disruptive and potentially dangerous consequences, they are usually relinquished early and replaced with intimidation, manipulation, deception. These can require special cognitive skills—lying and manipulating others effectively require cognitively advanced skills; intimidating takes courage and knowledge of one's social signal value.

Parents are undoubtedly greatly responsible (either consciously or unconsciously) in helping to train these skills—their child's future adaptation depends upon it, which also means that the parents' cultural and biological contribution to future generations also depends on it. Sibs and peers are probably just as responsible for socializing the child (Hartup, 1983) but usually for opposite reasons. Parents generally do not compete with their children until the latter interfere with the parents' own need for resources or investment in other children. Age mates, in contrast are frequently in direct competition with each other, even when they are friends.

Of the five classes of competition behavior, cooperation is the most socially acceptable and probably as easy to acquire as the other four. Positive social acts that constitute the class (as here defined) of cooperation, appear at roughly the same time ontogenetically as aggressive acts and certainly earlier than acts of intimidation, manipulation, and deception. The child learns very early that resources are not always forthcoming without effort. By the end of infancy increasingly more resources become contingent on behavior and hence increasingly more bound up with the behavior of others. By the time the child is a toddler single behaviors are not always effective—a chain of different behaviors is often required. Further, the child comes to discover that response efficacy depends on circumstances—sometimes a parent or sib responds positively, other times not. With different persons the best strategy is to

have different classes of actions ready to bring about a particular effect. Over ontogenetic time, different strategies or combinations of strategies are found to work or not work. In many situations it is conceivable that cooperation works to one's advantage if it is accompanied by a bit of manipulation or deception. Manipulation of others would seem to be a prevalent strategy, given its low relative costs (if one does not get caught) and avoidance of open conflict (Dawkins & Krebs, 1978). In other situations a departure from socially acceptable behavior such as a combination of deception and intimidation may be effective—defending a resource from a strong, threatening stranger may require such a mixture. The child must learn which strategy to apply in which situation. This is often no easy task and those who learn quickly and retain what they learn have a much better chance of adapting to chronically competitive situations.

Ontogenetic trends in strategy usage are clearly linked to both experience and level of cognitive development. Compared to a 10-year-old, an adolescent can effectively use a cooperation/deception strategy consisting of a very subtle mixture of friendliness and genuine helpfulness on one side and well-orchestrated fibs on the other, all aimed at acquiring a particular resource (LaFreniere, 1987). With age, though, one would expect an increase in the use of pure cooperation. With experience, the individual becomes accustomed to compromise, realizing that it is better to get a portion of the resource than none at all or to get none of the resource than to risk isolating someone who will be helpful later on. Of course, the strength of the need for the resource, its availability, and characteristics of other individuals seeking the resource also contribute to the determination of which strategy is used.

DEVELOPMENTAL TASKS

Ontogeny can be viewed from an evolutionary perspective as consisting of two major phases, prereproductive and reproductive. In the latter we can include providing children and grandchildren with resources as a vital contribution to reproduction. Daily maintenance (surviving) constitutes a major, ongoing task which contributes to ontogenesis and is, in turn, altered by developmental changes.

During the prereproductive phase the individual is faced with the task of changing from a dependent, reproductively immature organism whose adaptational capacities are limited, to an autonomous, reproductively mature organism whose adaptational capacities are adequate to cope effectively with environmental demands. Physical growth and maturation, autonomous learning, and socialization by parents and others constitute major determinants of such change.

During the reproductive phase, in contrast, the individual is faced with the task of finding a mate, bonding, producing and caring for

offspring, and at the same time acquiring resources needed for the offspring's successful adaptation and development. If the individual adopts as a goal ideal achievement (as defined above) as a substitute to reproduction, the second phase consists of acquisition of higher-level skills, development of relevant social contacts, and a professional life. Many individuals, of course, are guided by imperatives for both reproduction and ideal actualization.

In both phases two major factors operate—extrinsic factors such as climate, resource availability, competition from others, and intrinsic factors such as physiological and anatomical changes. The task of individuals is to find a working relationship between such factors that is to their own advantage. Advantage implies here satisfying the genetic imperatives of maintenance, development, reproduction, and ideal actualization. Part of this working relationship is already undertaken by parents invested in their offspring. But such an investment is not permanent; parents as a rule have other investments and usually do not survive their offspring. Also, the individual is equipped at birth to initiate behavioral solutions to such tasks—smiling, crying to obtain social resources; rooting, sucking to obtain nutritional resources. Later in development, the individual acquires the ability to perform more complicated behaviors with minimum practice—locomotion and object manipulation become effective means of exploring new physical and informational resources. Despite such adaptive skills, the environment is never totally supportive, and the skills never totally efficient. Successful adaptation, in other words, is always jeopardized to a lesser or greater degree and the individual is constantly faced with the task of dealing with problems caused by unavailable resources.

According to Havighurst (1972), the concept of developmental tasks constitutes a significant part of theoretical effort in traditional child psychology, going back at least to the 1930s. Such efforts, though, have not been matched by empirical research commensurate with their potential. This raises interesting historical questions, given that the developmental task notion has direct educational and clinical implications for child development practitioners.

Erik Erikson (1968) produced the first major unified theory of such tasks, viewing them from a cultural/psychoanalytical perspective and positing eight psychosocial developmental crises, each characterizing a particular time period from birth to late adulthood. For example, the first psychosocial crisis (from birth to two years) requires that the human infant achieve trust (as contrasted with mistrust) in other human beings—trust that all needs would be met, that friendly gestures would be reciprocated, etc. The task facing the infant is to establish an attachment relation with at least one warm and supportive caretaker (in the present scheme the most important resource for this developmental period). Parallel tasks also have to be solved, such as the cognitive

tasks of acquiring the concept of causality and object permanence both prerequisite to solving the greater, more complicated tasks of achieving trust. What is crucial for the individual is that success in each task is contingent on how well the previous task was solved. Thus, a young child who had not satisfactorily solved the third task of learning to overcome guilt fixations, would have difficulty overcoming feelings of inferiority by engaging in productive school work, acquiring adaptive social and physical skills, etc. In all instances the presence of a relevant resource is the *sine qua non* of task behavior: without the resource, development does not start, or if it does, fails to continue.

Havighurst's (1972) notion of developmental tasks shares similarities with Erikson's but focuses more upon educational/social goals. Havighurst's tasks have three possible origins—physical maturation (for example, the psycho/physical need to locomote and explore new stimuli), cultural pressure (being required by society to read), and personal values and aspirations (the need to build and adhere to particular long-term goals, values, and standards). As with Erikson's tasks, Havighurst's tasks have to be dealt with successfully to avoid difficulties and failures while dealing with later developmental tasks. Some tasks are viewed as universal (because they appear biologically based) while others are viewed as culturally relative. Also, some tasks, while appearing early in life, recur in different, if not miniaturized forms, throughout remaining life. Learning how to make and keep friends is an example.

Both Erikson's and Havighurst's models share many basic notions—tasks are imposed from intrinsic as well as extrinsic factors and appear during a particular ontogenetic time period; solutions to the tasks are dependent upon the quality of the solutions to developmentally earlier tasks. Modal experiences from the content of the various time periods are stressed, and differences between individuals facing the same task tend to be ignored. While ignoring individual differences makes the models of less value for sociobiological purposes, such models are nevertheless useful because they suggest uniformities in ontogenesis that conceivably reflect species-universal imperatives characterizing human ontogenesis. They also point to general, species-wide environmental conditions that appear to be strongly implicated in creating task conditions.

What is uniformly missing in such models is a detailed treatment of the environmental factors that initiate and control task-related behavior. Lacking such treatment, it is not surprising that little empirical research has been generated to test the utility of the models. Furthermore, there is no conceptual room in such models to incorporate individual/environment interaction. Such models need measures of individual traits, environmental conditions, and most importantly, how both interact over developmental time.

This last point cannot be stressed sufficiently. The environment rarely demolishes or shores up individuals without any effort or resistance on their part. Apart from rare events that occasion unforeseeable accidents and inescapable natural catastrophes, selection very frequently operates positively or negatively with the "complicity" of the organism. The notion that individuals help construct or choose their environments is well expressed from a genotype perspective by Plomin, DeFries, and Loehlin (1977) and by Scarr and McCartney (1983) in terms of personal characteristics influencing parental socialization strategies. Both approaches recognize the strong need for actual behavioral studies of parent/child interaction before making conclusions about directions of causality when discussing genotype/environment influences on behavior.

There are at least two general kinds of evidence suggesting complicity of the individual in an environmental event— (1) the same environmental event can have very different effects on different organisms depending on individual differences in terms of their active attempts to avoid, resist, or abet the event, and (2) organisms actively select and shape their environments to their own short- or long-term benefit. The notion that behavior plays an active role in shaping environmental events which in turn create new selection pressures (and hence plays a role in evolution) has been noted by Mayr (1970). The lesson to be learned from this is that while we can recognize the contributions of genotype and environment to behavior and take an interactionist position, we will make no progress towards understanding the nature of adaptation and the factors that support or threaten it until we study the process of adaptation itself.

A Research Model

As illustrated in Figure 2.4 one can view individual/environment interactions as being based on phylogenetic preconditions involving genetic imperatives and the required resources associated with them. Behavior can be viewed as the organism's primary strategy for acquiring resources from the environment. Figure 2.4 presents a schematic view of the basic elements involved in this approach and their interactions.

The core of the two concentric rings consists of the genotype fixed at conception for the remainder of ontogenesis (excluding infrequent instances of gene breakup) and consistent in carrying out the instructions for constructing the material basis of the individual (the first ring). The individual is genetically fixed by these instructions to produce a particular configuration of phenotype. This configuration, however, is developmentally variable: as noted above, the immature

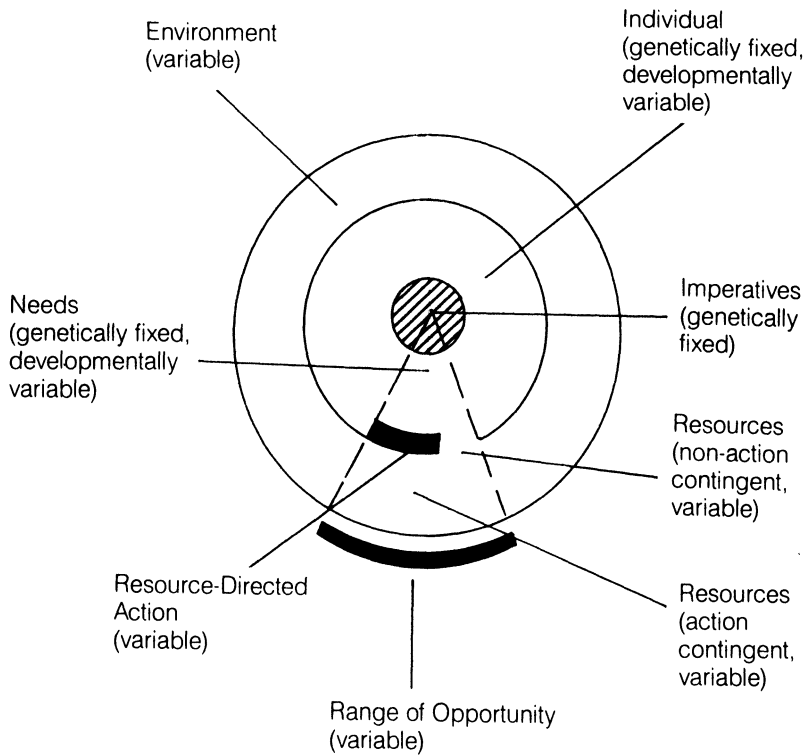


FIGURE 2.4. Hypothetical individual/resources relationships in terms of genetic imperatives, needs, resource-directed action, and resources.

individual differs substantially in many respects from the mature organism.

Part of the individual consists of needs systems (the wedge segment of the first ring, the size of which is discussed below). The needs system's main functions are to signal when the individual lacks resources and to motivate the organism to engage in resource-directed actions.

Resource-directed actions (the dark band straddling the border of the two rings) represent the major functional connection the individual has with the environment. Actions extend from the individual into the resource segment of the environment. Unlike needs which are genetically fixed and developmentally variable (needs can change with age), behaviors vary as a direct function of variations in the environment. As noted above, environments are frequently in flux and in effect compel individuals to them by altering their behavior. Besides putting stress upon individuals, environments supply them with resources (a segment of the second ring). Resources can be divided into nonaction-contingent resources, those which do not require behavior to be acquired (parental

care, anonymous donations), and into action-contingent, those which are directedly contingent on what the individual does to acquire them.

The last element in the model is the “range of opportunity,” the band marking the arc of the wedge and determining the size of its angle. At any point in time, a confluence of factors, each having its own causal weight, raises or lowers the probability that an individual will acquire a resource. These factors include dispositional traits of the individual such as ontogenetic status (maturity level), intelligence, motor/perceptual skills, personality characteristics, and social status. The factors also include environmental factors such as resource availability, number of competitors for resources, and time and space factors.

For comparison purposes, the magnitude of the range can be inferred from the frequency, intensity, and efficacy of the resource-directed actions as well as by the amount and quality of nonaction-contingent resources acquired by the individual. The nature of individual/other relationships can also be inferred from these elements.

For purposes of illustration, let us assume that in a given environment, the only stable major factor influencing the range of opportunity is ontogenetic status. Figure 2.5 depicts variations in such range as a function of six different levels of ontogenetic status. As can be seen in Figure 2.5 the range of opportunity increases with age, reaches a maximum during adulthood, and then decreases during senescence. The range is narrowest during infancy, when the individual’s world is limited by relatively undeveloped perceptual, cognitive, and motor competencies as well as a relatively restricted range of needs. The range is widest during adulthood when the individual is normally at the peak of competence development and possesses a wide range of primary and secondary or acquired needs.

A different picture is obtained, however, when we look at the relationship between resources and behavior. While requiring relatively few resources, the infant with average parents has virtually all of them available on a nonaction-contingent basis— food, care, temperature control, etc. are provided whether the infant seeks them or not. In contrast, for the adult virtually all resources are action-contingent—they must be sought, competed for, and defended. As the adult becomes senescent, the range of opportunity narrows, but the ratio of nonaction-contingent resources to action-contingent resources increases. Respect, pity, or hope for an inheritance may motivate others to provide resources to the aged regardless of their behavior.

We can create similar hypothetical differences holding developmental status constant and varying social or economic status of parents, geographic area, or some dimension of personality or intellectual functioning. In each case the range of opportunity would vary as well as the ratio of nonaction- to action-contingent resources. Figure 2.6 depicts

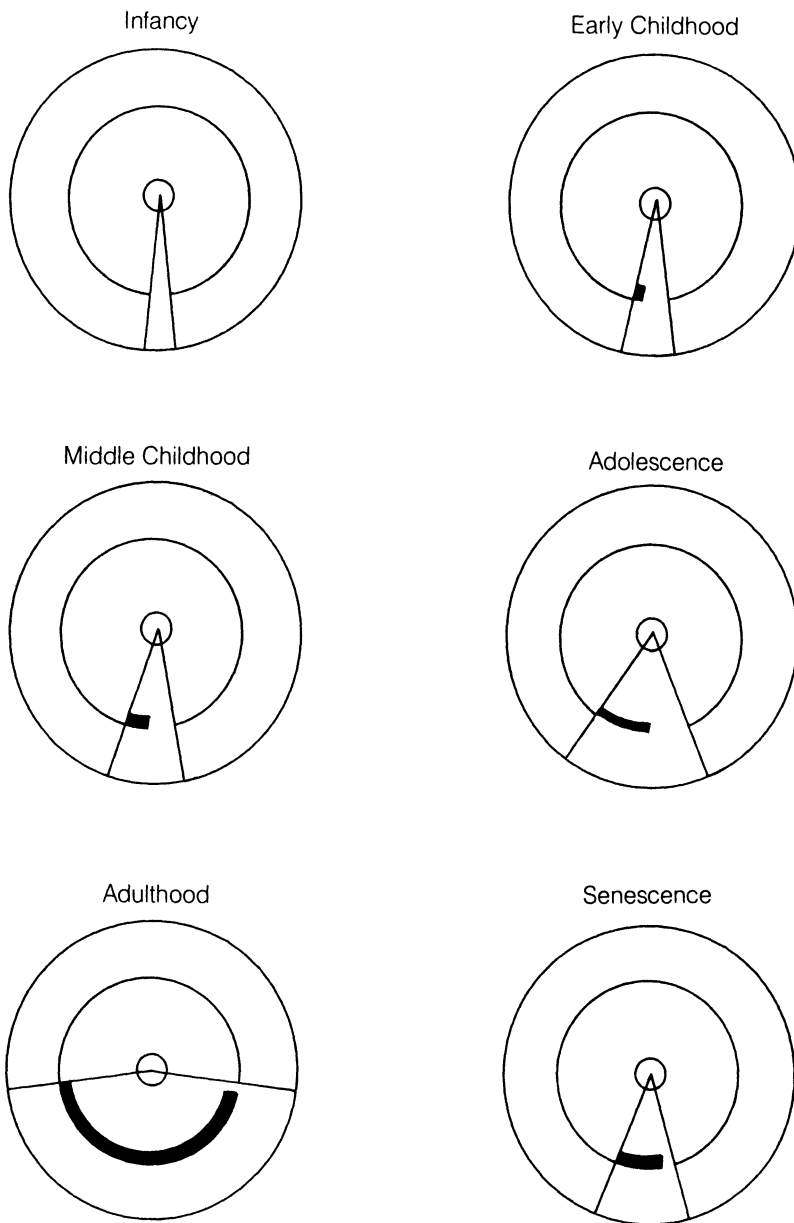


FIGURE 2.5. Hypothetical ontogenetic differences in individual/resource relationships.

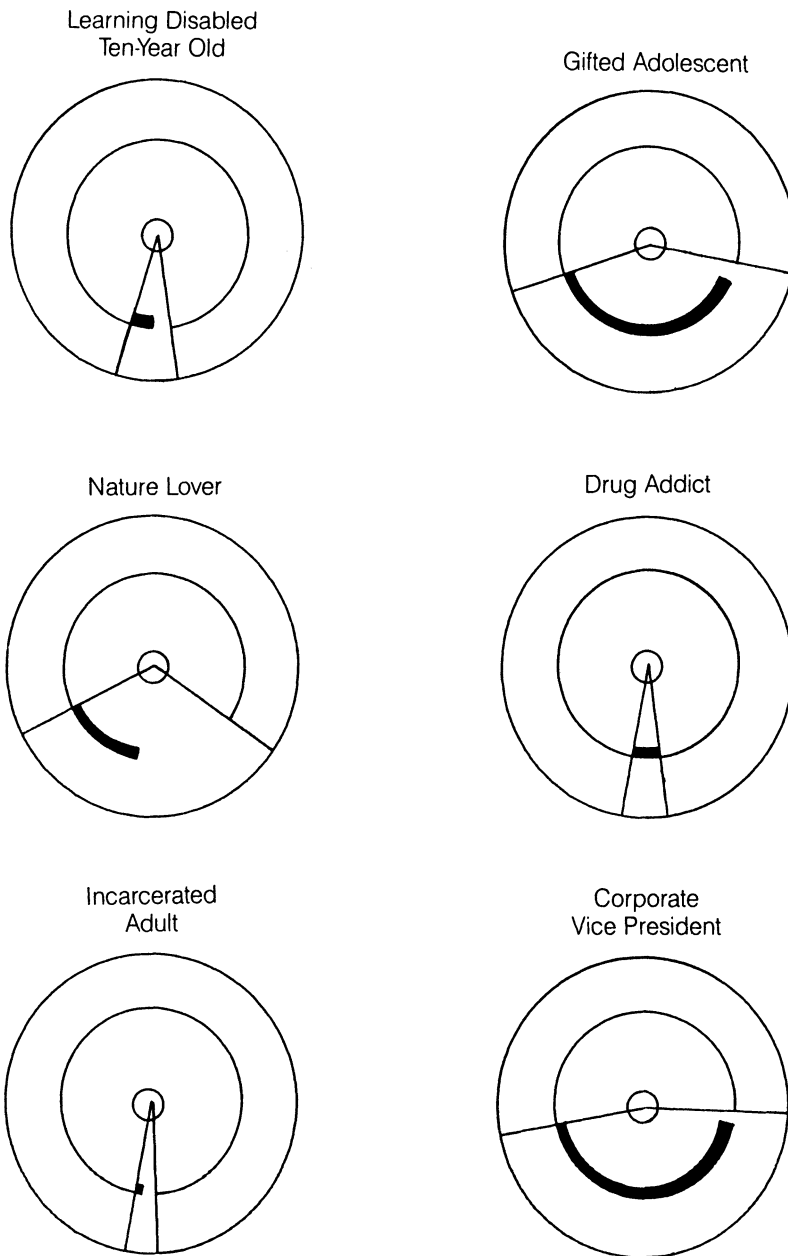


FIGURE 2.6. Hypothetical individual differences in individual/resource relationships.

individual differences based on differences in mental and emotional capacity, interests, as well as in social status contingent on prior behavior.

RESOURCES AND BEHAVIOR

For research purposes the present model provides two elements—resources and resource-directed action—which can be objectively identified and measured at any time point during ontogeny. From the former it is possible to infer needs characteristic of the individual; from the latter it is possible to assess the individual's behavioral style and overall behavioral efficacy. The latter also provides knowledge of those with whom the individual interacts. This makes it possible to know the nature of the individual's relationship with others. Let us illustrate these points with two hypothetical examples from early childhood. Resources and resource-directed behavior are italicized.

Child A is a 3-year-old born as the fourth child in a family with six children. The father works in a foundry and the mother works at home caring for the children and the household. A cries or whines for *something to eat or drink* on the average of eight times a day and succeeds on the average of 50% of the time when the crying is directed toward the mother and on the average of 10% of the time when it is directed toward a sib. A seeks in various ways (*asks, intrudes physically, runs along with others, climbs on swing with sib*, etc.) to play with older sibs on the average of three times a day and succeeds about 30% of the time. A's younger sib pesters A to play on the average of four times a day. A successfully *resists* intrusion into *own activity* 95% of the time. A makes on the average one attempt per day to *explore* the *neighborhood*, is blocked on the average of 70% of time from going out of the yard. A *asks* father about three times a week to buy *things seen on television*. Father says no or does not respond 100% of time. Father takes A and other children on long weekend hikes and provides *answers* to *questions* posed by A close to 100% of the time. *Father* complies close to 80% of the time to A's *request* (reaching up and whining) to be carried part of the way on the hike. Mother complies approximately 90% of the time when A *asks for* cough *medicine, a hug, or to be tucked in at bedtime*.

B is a 3-year-old born as the first child in a well-to-do family. The mother works as a statistical consultant for a prestigious firm, the father is an owner of a small, profitable computer sales company. B asks the full-time baby-sitter for snacks on the average of six times per day and is successful in getting them 80% of the time (usually in the afternoon). At 10:00 a.m. each weekday, B is told by the baby-sitter to practice the piano in preparation for a Saturday lesson. B is usually playing with art materials during this time or watching television and always

complains the first time the baby-sitter asks. B virtually always gives in after being asked the second time and plays for approximately 10 minutes then stops, *complaining* of fatigue. The baby-sitter gives B a *snack* for practicing. B returns to playing with the art materials. Afternoons, a playmate is brought to the house and B organizes the subsequent play activities, *commanding or pushing* (physically and verbally) the playmate on the average of 11 times during the two-hour play period *to do certain things*. The playmate concedes on the average of 90% of the time; when the playmate does not concede, B usually *changes the activity*, or *asks* the baby-sitter for a *snack*. The baby-sitter gives in on the average of 90% of the time. When the parents come home, B *reaches up to be lifted and be hugged* by both parents and succeeds each time, but while *attempting* to prolong the *hugging* is quickly put down each time. B ignores questions by mother on how the day went. At mealtime mothers asks B at least once to eat certain foods. B refuses on the average of 50% of the time and mother accepts the refusal each time. Father helps B to prepare for bed and reads a story to B before B falls asleep.

A and B obviously lead quite different lives. Both often want something to eat, but A's requests seem more based on hunger and tend to be less successful than B's in acquiring something. A has a wider range of needs than B (playmates, neighborhood sights, answers to questions, things seen on television); in addition to seeking snacks, B mostly seeks cooperation from the playmate or a hug from the parents. B is more successful than A in satisfying needs, but on the whole seems to have fewer of them. Demands made on time and activity are greatest for B, who is under pressure from (parents and baby-sitter), in contrast to A, who is under pressure only from the younger sib. In response to such demands, B is successful approximately 50% of the time, in contrast to A, who is successful almost all of the time. Both children employ roughly the same kinds of behavior—unambiguous, appropriate, a relatively simple mixture of verbal and physical.

In short, the life experiences and socialization of both children vary considerably. Consistent observation in representative settings of their everyday behavior and its relationship to their immediate environment in general and resources in particular can produce an objective picture of the nature of the child's adaptation. Such a picture allows us to obtain accurate measures of the frequency, range, and efficacy of the child's behavior as it is employed in acquiring and defending resources as well as measures of the nature and amount of resources available to the child. Such measures can be compared to more general "criterion" measures of the child's level of adaptation—later psychological and physical health, educational level, job satisfaction and success, general social status, and net worth. Variables are related in one way or another to the individual's impact on the population's future cultural/economic potential as well as genetic composition.

So far nothing has been said about the issue of the relationship between resource-acquisition and gene contribution to subsequent generations. A small but growing body of literature shows a positive relationship between resource abundance and reproductive success in humans (Driver, 1983; Hawthorn, 1970; U.S. Bureau of the Census, 1973; Irons, 1979; and Essock-Vitale, 1983). The acquisition of material resources (territory, access to food, material wealth) and mates in general appears positively connected to reproductive success or fitness (as relative to age cohorts in the same population or to an equilibrial replacement level or in terms of maximal fitness—Daly & Wilson, 1983).

Differential reproduction can be due to at least two kinds of behaviors—those that contribute positively to producing children and grandchildren (learning skills, working, good parenting, maintaining a positive social position, engaging in healthy activities, etc.), and those that contribute negatively (avoiding skill learning or working, poor parenting, engaging in antisocial behavior or unhealthy activities, adopting policies of remaining celibate and/or childless). Nonbehavioral factors conceivably contributing negatively to reproduction include severe congenital physical or mental handicap or retardation, debilitating disease, prereproductive mortality or incarceration, unforeseeable accidents, natural catastrophes, or uncontrollable political/social events (war and revolution) that lead to prereproductive injury or death.

Various researchers are pursuing the connections between early conditions or stress factors that put the child at developmental risk (see Garnezy & Rutter, 1983; Rutter & Garnezy, 1983). Developmental psychopathologists, in particular, bring attention to fact that the prevailing view of adaptation during childhood is essentially an interactional one in which stress signifies an imbalance between environmental demands and a person's resources that enable coping with such demands. The various indices and measures these researchers employ to establish adaptational level of the individual child are to date the best criterion measures of adaptation against which to compare observational data on individual/environment interaction. Given the recency of research in this area (most of the children studied have not reached the end of fertility) no data are available on the children's level of reproductive success. It will be interesting to see if what is designated as stressful imbalance between environmental demands and the individual's coping resources actually has reproductive consequences.

Let us turn now to an example of research based on the conceptual model dealing with the relationship between resources and behavior over ontogenesis and aimed at operationalizing individual concepts within the model. In a series of studies, the present author and colleagues (Charlesworth & Dzur, 1987; Charlesworth & LaFreniere, 1983; Dzur & Charlesworth, in press; LaFreniere & Charlesworth, 1983) constructed a group problem-solving situation for preschool children in

which a clearly defined resource could be obtained if the children cooperated to obtain it. Four children (ranging in age from 3.5 to 5.0 years) were given the opportunity to view a novel cartoon movie. One child could view the cartoon provided a second child turned on the movie light and a third child turned the crank to set the film in motion, the fourth child in the group thereby being left in a bystanding position. The situation called for a mixture of self-assertive or selfish behaviors that could include deception, manipulation, intimidation, or even aggression, as well as cooperative or altruistic behaviors. One had to get into the viewing position one way or another and then, when in the position, get the others to turn on the light and crank the switch. Dominance rank as established in the preschool classroom as well gender, age, friendship, and behavior were, as predicted, related to success as measured by number of seconds spent actually viewing the film. Also, as predicted successful children helped others view rather than spend time bystanding. Successful competitive behavior (in the traditional sense of the term) was, as the data indicated, significantly related to cooperative behavior (traditionally defined). In terms of the present definitions, cooperation coupled with assertiveness was a good strategy for successful competition. Not only did the successful child help others on occasion (too much assistance, however, was not adaptive since that cut into one's viewing time) and thereby show cooperative behavior but cliques of friends would happily cooperate, thereby giving each other opportunity to enjoy the resource while simultaneously denying it to the child outside of the clique. Cooperation, in other words, turned out to be an effective method of competition. As was also expected, there were great individual differences in how much of the available resource (seconds viewing the cartoon) the children obtained. Some of these differences were due to the individual's dominance status as observed in the classroom and rated by teachers.

In addition to testing the concept of cooperation as a form of competition, the above studies had a methodological aim as well. The question was, given a known resource, what acts were specifically directed toward acquiring it and what acts were generally associated with acquiring it. This question has special significance for naturalistic observation because the observer often has to infer the goal of a particular behavior from the nature of the behavior itself as well as the context of the situation. An exhaustive analysis of videotapes of the children working with the movie viewer revealed eight discrete verbal behaviors (for example: requests, appeals to turn-taking, shows concern, negative commands, and threatens or ridicules), and seven discrete physical behaviors (for example, approaches, touches, blocks, disrupts, and attacks). Some of these behaviors were directly related to obtained viewing time (such as commands to turn on the light and crank) and others were associated with viewing time (more for girls than boys).

With knowledge of resource-directed behavior for both the experimental and the observational studies it was possible to build an observational scheme that can identify the major resource-acquisition behaviors in the nursery school setting and, in turn, the major resources sought by them. This scheme was developed under the rubric of HOW for "having one's way," a concept covering a wide range of behaviors that individuals of any age employ to acquire resources. An analog of the HOW concept was used with older individuals by Kipnis, Schmidt, and Wilkinson (1980), who examined 14 tactics that lower-level managers use to influence others in their organization. These tactics included a very wide range of behaviors, not only those that could be judged dominant as noted above. They included lying, cajoling, manipulating, becoming a nuisance, expressing anger, reporting the person to a supervisor, training an individual, rewarding, directly requesting, demanding, and forming coalitions with others. This list represents a very parsimonious way of dealing with goal-directed behavior.

It should be noted that, besides drawing on earlier PROBA concepts (Charlesworth, 1979), the HOW method itself employs methodological concepts and procedures also used by a wide range of observational studies in the child development literature—for example, a category scheme for coding interpersonal behavior developed by Longabaugh (1963), Shure's (1963) pioneering study on the psychological ecology of the nursery school, McGrew's (1972) and Blurton Jones's (1972) classic ethogram work on preschool behavior, Smith and Connolly's (1980) thorough study of the ecology of preschool behavior. It should be further noted that the measures of dominance (as well as the dominance concept itself as applied to young children's groups) were heavily influenced by the pioneering work of Omark, Strayer and others (see Omark, Strayer, & Freedman, 1980). In short, many of the ingredients of the HOW approach are already part of the working methods of field researchers working with young children. However, to the present author's knowledge, the particular combination of these ingredients as applied on the wide front (attempting to cover exhaustively all resources—physical, social, and informational—and all the behaviors used to acquire them) by the HOW approach has not yet been employed by researchers.

Extensive reconnaissance observation followed by more systematic observation revealed that it was possible to identify and classify preschool resources reliably and objectively into five major categories, the behaviors used to acquire resources into nine major categories, reactions to such behaviors into three categories, and outcomes of the interaction into three categories. These categories have been used successfully with interobserver agreements ranging from 60% to 98% (depending on class of categories). Data collected to date on over 60 children in classrooms well provisioned with toys, space, and teachers reveal

that social resources, especially attention and participation from the teachers and from playmates, were most frequently sought by means of making statements and requests. Success rates were in the 80- to 90% range especially with teachers. In view of these data the classrooms are relatively comfortable, civilized (virtually no aggressive acts were observed) places for the children to spend their time. Individual differences were obtained on all categories so there is good reason to believe that the environment means different success/failure experiences for different children.

This brings us to the final feature of the present model. Field observation constitutes the critical method for studying human adaptation. There are a number of standard reasons for this. Observation allows us to obtain objective information on the nature of an individual's resource environment and the condition under which the individual has to obtain resources. Furthermore, it allows us to identify and document the kinds and frequencies of behaviors the individual employs to acquire the resources (thus giving us a good idea of the range of the individual's adaptive abilities during various developmental periods) and gives us a hard measure of how successful the individual is in acquiring resources.

The two children described in the example above have been observed to lead different lives. If it were possible to obtain an adequate sample (monthly in two or three common everyday settings over a two-year period), we would have a good picture of the nature of their resource environment and their capacity to deal with it over developmental time. We would have precise, detailed descriptions of their interactions, against which we could compare independent measures of adaptation. Relating observational data to general measures of emotional and physical health, developmental status, educational success (when the children reach the school years), social adaptation outside the home, and other standard indices of adaptation would give us solid measures of predictor variables for later adaptation and reproductive success.

The obvious disadvantages of obtaining data this way is the labor involved, the possibility of sample bias (only individuals who allow daily scrutiny, or only situations in which such scrutiny is allowed), and the uncertainty of knowing (until after the effort has been made) whether the concepts of resources and resource acquisition are actually fruitful concepts for the task. An additional disadvantage of collecting longitudinal data on children is that the interesting information on adult adaptation and reproductive success will not appear until some years after the researcher has retired from the scene.

Such disadvantages may appear discouraging. But there are ways to solve the observational problems. Training parents, teachers, and others close to the person being studied to be resource/behavior raters, or interviewing persons about their preferences and successes or failures, while not ideal procedures, may be adequate if carried out regu-

larly with proper sampling. As for the question of the child outliving the researcher, it should be kept in mind that ontogeny has many stages or periods of different kinds and levels of adaptation, and the researcher can concentrate profitably upon a single period in the lifespan (the first five years for example) and survive to see later developmental results while passing the data on to a younger generation of researchers.

A further vexing problem with the present approach has to do with inferring causal connections between behavior and measures of adaptation and reproductive success. Objectively establishing the proportion of successful resource-acquisition behaviors still does not allow us to conclude with certainty the degree to which such behaviors have beneficial consequences toward meeting the genetic imperatives. As Hinde (1975) points out, observational evidence can only provide "at most indirect evidence about the action of natural selection . . ." (p. 9).

Given the disadvantage of and problems with the present approach it may appear too great a risk to invest in it. However, the question remains as to what at present is a better alternative.

Conclusion

For the first time since Darwin the study of human behavior is on the verge of being significantly influenced by evolutionary theory. The nature/nurture issue which has deep roots in Western thought, including Darwin's theory, has dominated the behavioral sciences for over a century. Based on a troublesome, but in some ways useful, dichotomy, this issue is only tangential to the main point that Darwin made. Darwin's major insight was that all forms of life are under two kinds of pressure—genetic pressure to survive, develop, and reproduce by acquiring necessary resources, and environmental pressure in the form of competitors that thwart the acquisition process. The disruptive interaction between these two pressures serves as the causal basis for evolution, and it is the main thesis of this chapter that this interaction has to be the focus of scientific study.

Despite Darwin, several generations of researchers, while acknowledging that phenotypes resulted from genotype/environment interaction, tended either to ignore one or the other, or to give one less rigorous attention in hopes of demonstrating that the other had a heavier causal weight in determining a particular aspect of human behavior. On one hand, most social scientists, for example, who believed that environment was paramount in shaping human behavior, conducted studies without controlling for possible genetic effects, a task not impossible to carry out if one included sibs, twins, or adopted children in one's sample. On the other hand, most behavioral geneticists, while often showing more sensitivity to opposing beliefs than the environmentalists, did

little more than list such demographic factors as social class, parent income, and educational level as their measures of environment. Detailed, objective descriptions of environments necessary for specifying the causal factors that influence behavior have seldom if ever been part of the behavior genetics method.

To make matters less promising for Darwin's insight, virtually no researchers studying humans directly examined gene/environment interaction. The few researchers (mostly naturalistic observers) who did examine individual/environment interactions were usually not interested in how genes and environment interacted. In other words, the great majority of behavioral scientists studying humans truncated the subject matter of their discipline for a whole century after Darwin. They did this despite the fact that Darwin had shown that nothing in nature is truncated and should not be truncated (even for scientific purposes) if we want to understand it fully.

Evolutionary biologists studying animals seem to have a slightly better record in this regard than social scientists. However, it has taken many evolutionary biologists' conscious effort to recognize that organism/environment interaction is the most profitable way to conceptualize behavioral research. Not until fairly recently have behavioral biologists made efforts to develop a science of ecology that not only describes environmental factors but views them in interaction with behaviors and hence causally implicated in the processes responsible for adaptation and reproduction. Historically, much research was conducted in evolutionary biology before it was realized that animal behavior can best be understood by focusing on the various economic relationships connecting the individual and local environmental conditions. Only in the past decade or so, for example, have cost/benefit ratios of behavior strategies been seen as critically related to reproductive success. Also, it took biologists decades of effort after Darwin to recognize that the study of genetics is incomplete without the study of populations and ecology. This point is made very well by Krebs & Davies (1987) in their exploration of the relationships between animal behavior, its current survival value, and its connections to ecology and evolutionary history.

One crucial element, however, a relatively recent newcomer to the evolutionary approach to behavior, has still to enter the picture Darwin sketched out. This element is ontogeny, the various changes that characterize the lifespan of the individual. We now know that the frequent chance nature of intrusive environmental factors introduces a wide margin of unpredictability into ontogeny. As a consequence, selection agents seldom have a single target to operate upon because the same individual presents a different phenotypic target at different periods during the lifespan (a fact that should once and for all discourage facile explanations of the role selection factors play in shaping individual adaptation and fitness). Only when ontogeny is approached by means of descriptive, prospective longitudinal studies of individ-

ual/environment interactions in which individuals of varying degrees of genetic relatedness are included can behavioral scientists legitimately generate hypotheses about causal connections between genetically conditioned traits, environmental selection pressures, and reproductive success.

Given such a history, the future of Darwin's insight for studying human behavior at first glance may not appear promising. Today, however, behavioral scientists, fortunately, are at a point when the major conceptual dimensions that make up the context of human adaptation are in place and ready to structure empirical research. Darwin and his successors have provided a conceptual synthesis that has the capacity to do the enormous job such research requires. It is now up to behavioral scientists working with humans to help frame this synthesis in operational terms. Only then can the necessary research be carried out to test sociobiological hypotheses about human behavior. To simplify this task, research models are needed.

The behavior/resource model sketched out in this chapter is a small step in this direction. It fits into Darwin's framework and ties in with some of the major theoretical and empirical efforts of both traditional biology and developmental psychology. Its main purpose is to stimulate the collection of data on the relationship between human behavior and the resources that keep humans functioning and developing. Its ultimate goal is to produce descriptions of the nature of the developing child's behavior and resource environment, and how the interaction between them influences the child's level of adaptation. The model can be applied to adult behavior as well.

Traditionally, longitudinal, observational research is cumbersome and labor-intensive, especially when compared to testing or experimentation. The present model makes a conscious attempt to minimize these difficulties by reducing individual/environment interactions to resources and resource-directed behavior, sampling daily life situations carefully, and focusing on short time segments of development. Cutting through the rich complexities of daily life with such a simplified approach has obvious risks. Its only defense is that it makes sense from an evolutionary point of view, is relatively easy to apply, and can produce objective data on individual/environment interaction. These data will help speed up our understanding of the relationship between human adaptation over ontogeny and the environmental conditions surrounding it. Hopefully, such understanding will enable us to address better the interesting questions sociobiologists are now formulating about human behavior and its relationship to reproductive success.

Acknowledgments. Thanks go to Kevin MacDonald and Claire Dzur-Harkness for their comments on the first draft of this chapter. Also, many thanks to LuJean Huffman-Nordberg, super secretary, who saw

this chapter through to its printed end, and to Kaye O'Geay, who helped the author move into the era of personal computers. Many thoughts that went into this chapter emerged while the author was an Alexander von Humboldt Stipendiat at the Max Planck Institute for Psychiatry, Munich, Germany. Gratitude goes to both institutions for their generosity and support and to the University of Minnesota for a single quarter leave during which this chapter was completed.

REFERENCES

- Alcock, J. (1979). *Animal behavior*. Sunderland, MA: Sinauer Associates.
- Alexander, R. (1974). The evolution of social behavior. *Annual Review of Ecology and Systematics*, 5, 325–383.
- Alexander, R. (1975). The search for a general theory of behavior. *Behavior Science*, 20, 77–100.
- Allport, G.W. (1985). The historical background of social psychology. In G.L. Lindzey & E. Aronson (Eds.), *Handbook of social psychology*. New York: Random House.
- Barash, D. (1976). Some evolutionary aspects of parental behavior in animals and man. *American Journal of Psychology*, 89, 95–127.
- Barash, D.P. (1982). *Sociobiology and behavior* (2nd ed.). New York: Elsevier.
- Barker, R.G. (1963). The stream of behavior as an empirical problem. In R.G. Barker (Ed.), *The stream of behavior: Explorations of its structure and content*. New York: Appleton, Century-Crofts.
- Barker, R.G., & Wright, H. (1971). *Midwest and its children*. Hamdon, CT: Archon Books.
- Barkow, J.H., & Burley, N. (1980). Human fertility, evolutionary biology, and the demographic transition. *Ethology and Sociobiology*, 1, 163–180.
- Bennett, J.W. (1976). *The ecological transition: Cultural anthropology and human adaptation*. New York: Pergamon Press.
- Betzig, L.L. (1986). *Despotism and differential reproduction: A Darwinian view of history*. Hawthorne, NY: Aldine Publishing Co.
- Blau, P.M. (1964). *Exchange and power in social life*. New York: John Wiley.
- Blurton Jones, N. (1972). Categories of child-child interaction. In N. Blurton Jones (Ed.), *Ethological studies of child behavior*. Cambridge: The University Press.
- Bryant, B. (1985). The neighborhood walk: Sources of support in middle childhood. *Monographs of the Society for Research in Child Development*, 50 (3, Serial No. 210).
- Buss, D.M., & Craik, K.H. (1980). The frequency concept of disposition: Dominance and prototypically dominant acts. *Journal of Personality*, 48(3), 379–392.
- Chagnon, N.A., & Irons, W. (Eds.). (1979). *Evolutionary biology and human social behavior: An anthropological prospective*. North Scituate, MA: Duxbury Press.
- Charlesworth, W.R. (1979). An ethological approach to studying intelligence. *Human Development*, 22, 212–216.

- Charlesworth, W.R. (1982). The ontogeny of political behavior: An outline for research. *American Behavioral Scientist*, 25, 273–293.
- Charlesworth, W.R., & Dzur, C. (1987). Gender comparisons of preschoolers' behavior and resource utilization in group problem solving. *Child Development*, 58, 191–200.
- Charlesworth, W.R., & LaFreniere, P. (1983). Dominance, friendship, and resource utilization in preschool children's groups. *Ethology and Sociobiology*, 4(3), 175–186.
- Corsini, R.J. (Ed.). (1984). *Encyclopedia of psychology*. New York: John Wiley.
- Craig, W. (1921). Why do animals fight? *International Journal of Ethics*, 31, 264–278.
- Crook, J.H. (1971). Sources of cooperation in animals and man. In J.F. Eisenberg & W.S. Dillon (Eds.), *Man and beast: Comparative social behavior*. Washington, DC: Smithsonian Institution Press.
- Daly, M., & Wilson, M. (1983). *Sex, evolution, and behavior* (2nd ed.). Boston: PWS Publishers.
- Dawkins, R., & Krebs, J.R. (1978). Animal signals: Information or manipulation? In J.R. Krebs & N.B. Davies (Eds.), *Behavioral ecology: An evolutionary approach*. Sunderland, MA: Sinauer Associates.
- Driver, E.D. (1983). *Differential fertility in central India*. Princeton: Princeton University Press.
- Dzur, C. & Charlesworth, W.R. (submitted for publication). Age comparisons of preschoolers' behavior and resource utilization in mixed-age problem solving groups.
- Emlen, J.M. (1973). *Ecology: On an evolutionary approach*. Reading, MA: Addison-Wesley.
- Emlen, S.T. (1980). Ecological determinism and sociobiology. In G.W. Barlow & J. Silverberg (Eds.), *Sociobiology: Beyond nature/nurture?* Boulder: Westview Press.
- Erikson, E. (1968). *Identity: Youth and crisis*. New York: Norton.
- Essock-Vitale, S.M. (1983). The reproductive success of wealthy Americans. *Ethology and Sociobiology*, 5, 45–49.
- Essock-Vitale, S., & McGuire, M. (1980). Predictions derived from the theories of kin selection and reciprocity assessed by anthropological data. *Ethology and Sociobiology*, 1, 233–243.
- Essock-Vitale, S.M., & McGuire, M.T. (1985). Women's lives viewed from an evolutionary perspective. II. Patterns of helping. *Ethology and Sociobiology*, 6, 155–173.
- Foa, E.B., & Foa, U.G. (1980). Resource theory: Interpersonal behavior as exchange. In K.J. Gergen, M.S. Greenberg, & R.H. Willis (Eds.), *Social exchange: Advances in theory and research*. New York: Plenum.
- Foa, U.G. (1971). Interpersonal and economic resources. *Science*, 171, 345–351.
- Frese, M.I., & Sabini, J. (1985). *Goal-directed behavior: The concept of action in psychology*. Hillsdale, NJ: Lawrence Erlbaum.
- Garnezy, N., & Rutter, M. (Eds.). (1983). *Stress, coping, and development in children*. New York: McGraw-Hill.
- Geist, V. (1978). *Life strategies, human evolution, environmental design: Toward a biological theory of health*. New York: Springer-Verlag.

- Ghiselin, M.T. (1974). *The economy of nature and the evolution of sex*. Berkeley: University of California Press.
- Ghiselin, M.T., & Scudo, F.M. (1986). The bioeconomics of phenotypic selection. (Comment on D. Vining, Social versus reproductive success: The central theoretical problems of human sociobiology). *The behavioral and brain sciences*, 9, 194-195.
- Gould, J.L., & Marler, P. (1987). Learning by instinct. *Scientific American*, 256(1), 74-85.
- Gould, S.J. (1977). *Ontogeny and phylogeny*. Cambridge, MA: The Belknap Press of Harvard University Press.
- Graziano, W. (1984). A developmental approach to social exchange processes. In S.C. Masters & K. Yarkin-Levin (Eds.), *Boundary areas in social and developmental psychology*. New York: Academic Press.
- Gump, P.V. (1967). The classroom behavior setting: Its nature and relation to student behavior. *Final Report to U.S. Office of Education*, Project No. 5-0334.
- Hamilton, W.D. (1964). The genetical evolution of social behavior: I & II. *Journal of theoretical biology*, 7, 1-52.
- Harre, R., & Lamb, R. (Eds.). (1983). *The encyclopedic dictionary of psychology*. Cambridge, MA: The MIT Press.
- Harris, M. (1979). *Cultural materialism*. New York: Random House.
- Hartup, W.W. (1983). Peer relations. In P.H. Mussen & E.M. Hetherington (Eds.), *Carmichael's manual of child psychology* (4th ed.). Vol. 4. New York: John Wiley.
- Havighurst, R.J. (1972). *Developmental tasks and education*. New York: Longman, Inc.
- Hawthorn, G. (1970). *The sociology of fertility*. London: Collier-MacMillan.
- Hill, J. (1984). Prestige and reproductive success in man. *Ethology and Sociobiology*, 5, 77-95.
- Hinde, R.A. (1975). The concept of function. In C. Baerends, C. Beer & A. Manning (Eds.), *Function and evolution in behavior*. Oxford: Clarendon Press.
- Hinde, R.A. (1979). *Towards understanding relationships*. New York: Academic Press.
- Hobbs, N. (1980). An ecologically oriented, source-based system for the classification of handicapped children. In S. Salzinger, J. Autrobus, & J. Glick (Eds.), *The ecosystem of the "sick child"*. New York: Academic Press.
- Homans, G.C. (1961). *Social behavior: Its elementary forms*. New York: Harcourt, Brace, and World.
- Homans, G.C. (1974). *Social behavior: Its elementary forms* (rev. ed.). New York: Harcourt Brace Jovanovich.
- Hull, C.L. (1952). *A behavior system*. New Haven: Yale University Press.
- Irons, W. (1979). Cultural and biological success. In N.A. Clagnon & W. Irons (Eds.), *Evolutionary, biology and human social behavior: An anthropological perspective*. North Scituate, MA: Duxbury Press.
- Johnson, D.W., & Johnson, R.T. (1974). Instructional goal structure: Cooperative, competitive, or individualistic. *Review of Education Research*, 44, 213-240.
- Kipnis, D., Schmidt, S.M., & Wilkinson, I. (1980). Intraorganizational influence tactics: Explorations in getting one's way. *Journal of Applied Psychology*, 65, 440-452.

- Kitcher, P. (1985). *Vaulting ambition: Sociobiology and the quest for human nature*. Cambridge, MA: The MIT Press.
- Krebs, J.R., & Davies, N.B. (1987). *An introduction to behavioral Ecology* (2nd ed.). Sunderland, MA: Sinauer Associates, Inc.
- LaFreniere, P.J. (1987). The ontogeny of tactical deception in humans. In R. Byrne & A. Whiten (Eds.), *Social expertise and the evolution of intellect: Evidence from monkeys, apes and humans*. Oxford: Oxford University Press.
- LaFreniere, P., & Charlesworth, W.R. (1983). Dominance, affiliation, and attention in a preschool group: A nine-month longitudinal study. *Ethology and Sociobiology*, 4, 55–67.
- Lewin, K. (1935). *A dynamic theory of personality*. New York: McGraw-Hill.
- Longabaugh, R. (1963). A category systems for coding interpersonal behavior as social exchange. *Sociometry*, 26(3), 319–344.
- Lynn, M., & Oldenquist, A. (1986). Egoistic and nonegoistic motives in social dilemmas. *American Psychologist*, 529–534.
- MacDonald, K. (1984). An ethological-social learning theory of the development of altruism: Implications for human sociobiology. *Ethology and Sociobiology*, 5(1), 97–109.
- May, M.A., & Doob, L.W. (1937). *Competition and cooperation*. New York: Social Science Research Council.
- Maynard Smith, J. (1971). Game theory and the evolution of behavior. *Proceedings of the Royal Society of London*, 205, 475–488.
- Mayr, E. (1970). *Populations, species, and evolution*. Cambridge: Harvard University Press.
- Mayr, E. (1974). Behavior programs and evolutionary strategies. *American Scientist*, 62, 650–659.
- McFarland, D. (1982). *The Oxford companion to animal behavior*. Oxford: Oxford University Press.
- McGrew, W.C. (1972). *An ethological study of children's behavior*. New York: Academic Press.
- Mead, M. (1937). *Cooperation and competition among primitive people*. New York: McGraw-Hill.
- Micklin, M. (1984). The ecological perspective in the social sciences: A comparative overview. In M. Micklin & H.M. Choldin (Eds.), *Sociological human ecology: Contemporary issues and applications*. Boulder: Westview Press.
- Miller, G.A., Galanter, E., & Pribram, K.H. (1960). *Plans and the structure of behavior*. New York: Holt.
- Murphy, G. (1954). Social motivation. In G. Lindzey (Ed.), *Handbook of social psychology*, Vol. 2. Cambridge, MA: Addison-Wesley.
- Murray, H.A. (1938). *Explorations in personality*. New York: Oxford University Press.
- Odum, E.P. (1983). *Basic ecology* (3rd ed.). Philadelphia: Saunders.
- Omark, D.R., Strayer, F.F., & Freedman, D.G. (Eds.). (1980). *Dominance relations: An ethological view of human conflict and social interaction*. New York: Garland STPM Press.
- Parsons, T., & Shils, A., et al. (Eds.). (1951). *Toward a general theory of action*. Cambridge: Harvard University Press.
- Parsons, T., & Smelser, N.J. (1956). *Economy and society*. Boston: Routledge & Kegan Paul.

- Platt, R.B., & Reid, G.K. (1967). *Bioscience*. New York: Van Nostrand Reinhold Company.
- Plomin, R., DeFries, J.C., & Loehlin, J.C. (1977). Genotype-environment interaction and correlation in the analysis of human behavior. *Psychological Bulletin*, 84, 309-322.
- Ricklefs, R.E. (1979). *Ecology* (2nd ed.). Portland, OR: Chiron Press.
- Rutter, M., & Garmezy, N. (1983). Developmental psychopathology. In E.M. Hetherington (Ed.), *Carmichael's manual of child psychology* (Vol. 4). *Social and personality development*. New York: John Wiley.
- Rushton, J.P., Fulker, D.W., Neale, M.C., Nias, D.K.B., & Eysenck, H.J. (1986). Altruism and aggression: The heritability of individual differences. *Journal of Personality and Social Psychology*, 50(6), 1192-1198.
- Rushton, J.P., Russell, R.J.H., & Wells, P.A. (1984). Genetic similarity theory: Beyond kin selection. *Behavior Genetics*, 14(3), 179-193.
- Samuelson, P.A. (1976). *Economics* (10th ed.). New York: McGraw-Hill.
- Scarr, S., & McCartney, K. (1983). How people make their own environments: A theory of genotype-environment effects. *Child Development*, 54, 424-435.
- Seymour, S. (1981). Cooperation and competition: Some issues and problems in cross-cultural analysis. In R.H. Monroe, R.L. Monroe, & B.B. Whiting (Eds.), *Handbook of cross-cultural human development*. New York: Garland STPM Press.
- Shure, M.B. (1963). Psychological ecology of a nursery school. *Child Development*, 34, 979-992.
- Sills, D.L. (Ed.). (1968). *International encyclopedia of the social sciences*. New York: Macmillan Co. and the Free Press.
- Silver, M. (1985). "Purposive behavior" in psychology and philosophy: A history. In M. Frose & J. Sabini (Eds.), *Goal-directed behavior: The concept of action in psychology*. Hillsdale, NJ: Lawrence Erlbaum.
- Smith, M.J. (1979). Games, theory and the evolution of behavior. *Proceedings of the Royal Society, Series B*, 205, 475-488.
- Smith, P.K., & Connolly, K.J. (1980). *The ecology of preschool behavior*. Cambridge: Cambridge University Press.
- Sprout, H., & Sprout, M. (1965). *The ecological perspective on human affairs*. Princeton, NJ: Princeton University Press.
- Starr, C., & Taggart, R. (1984). *Biology: The unity and diversity of life* (3rd ed.). Belmont, CA: Wadsworth.
- Thibaut, J.W., & Kelley, H.H. (1959). *The social psychology of groups*. New York: John Wiley.
- Trivers, R. (1971). The evolution of reciprocal altruism. *Quarterly Review of Biology*, 46, 35-57.
- Trivers, R. (1972). Parental investment and sexual selection. In B. Campbell (Ed.), *Sexual selection and the descent of man*. Chicago: Aldine.
- Trivers, R. (1974). Parent-offspring conflict. *American Zoologist*, 14, 249-264.
- Trivers, R. (1985). *Social evolution*. Menlo Park, CA: The Benjamin-Cummings Publishing Company.
- U.S. Bureau of Census (1973). Census of population: 1970. Subject Reports. Final report PC (2)-3A. Women by number of children everborns. Washington, D.C.: U.S. Printing Office.

- von Cranach, M., & Harre, R. (Eds.). (1982). *The analysis of action*. New York: Cambridge University Press.
- Walster, E., Walster, G.W., & Berscheid, E. (1978). *Equity: Theory and research*. Boston: Allyn & Bacon.
- Weigel, R.M. & Weigel, M.M. (1987). Demographic factors affecting the fitness of polyandry for human males: a mathematical model and computer simulation. *Ethology and Sociobiology*, 8, 93-133.
- Weisfeld, G. (1980). Social dominance and human motivations. In D.R. Omark, F.F. Strayer, & D.G. Freedman (Eds.), *Dominance relations: An ethological view of human conflict and social interaction*. New York: Garland STPM Press.
- Whiting, J.W.M. (1960). Resource mediation and learning by identification. In I. Iscoe & H. Stevenson (Eds.), *Personality development in children*. Austin: University of Texas Press.
- Wiens, J.A. (1977). On competition and variable environments. *American Scientist*, 65, 590-597.
- Willems, E.P. (1973). Behavioral ecology and experimental analysis: Courtship is not enough. In J.R. Nesselroads & H.W. Reese (Eds.), *Life-span developmental psychology*. New York: Academic Press.
- Williams, G. (1966). *Adaptation and natural selection*. Princeton, NJ: Princeton University Press.
- Williams, G. (1975). *Sex and evolution*. Princeton, NJ: Princeton University Press.
- Wilson, E.O. (1975). *Sociobiology: The new synthesis*. Cambridge, MA: Harvard University Press.
- Wittenberger, J.F. (1981). *Animal social behavior*. Boston: Duxbury Press.
- Zahn-Waxler, C., Cummings, E.M., Iannotti, R. (eds.). (1986). *Altruism and aggression: Biological and social origins*. New York: Cambridge University Press.

3

Toward a Developmental Evolutionary Ecology of Humans

JAMES S. CHISHOLM

Introduction

In the past decade sociobiology has massively transformed theory and research in the social and behavioral sciences but has had little impact on the developmental sciences. The reason for sociobiology's successes—and the one concept that makes it different from the other, older evolutionary approaches to behavior—is the concept of inclusive fitness. This is because being against the concept of inclusive fitness is like being against the concept of gravity: the logic of inclusive fitness theory is simply irrefutable. At the same time, however, the reasons for sociobiology's failure in the developmental sciences is also due to the concept of inclusive fitness, for this concept tells us little about the relationship of the genotype to the phenotype (e.g., Bateson, 1982). Since the relationship of the genotype to the phenotype can only be a developmental one, it stands that any evolutionary approach to behavior must be based on more than the concept of inclusive fitness. It must also be based on an evolutionary model of development. My purpose in this chapter is thus to outline some of the features such models will likely incorporate, and in so doing, to illustrate the value of thinking about human development in the terms of life history theory. I will begin with a brief description of the differences between sociobiology and evolutionary ecology and how these differences have fostered the development of life history theory. I will then sketch the central tenets of life history theory and provide the evolutionary biological and ecological reasons why the relationship of the genotype to the phenotype is not a constant, either within or between species. I will also argue why the relationship of the genotype to the phenotype may be especially *indeterminant* in *Homo sapiens*. Finally, with brief examples from recent work in anthropology, I will suggest some of the implications for theory and research that follow from thinking of human development in life history terms.

Life History Theory

THE MISSING PHENOTYPE

As is well known, Charles Darwin had no knowledge of genetics, and his theory of adaptation by natural selection needed (in addition to Mendel) Haldane, Fisher, and Wright before it could achieve the power it has today. However, there have always been a few (C.H. Waddington is the best familiar example) who were troubled by the New Synthesis' lack of attention to the phenotype. Today, in the form of life history theory, there is a resurgence of interest in the phenotype, and I think Waddington will be seen as one of the spiritual fathers of life history theory because its single most powerful impetus as an area of study has been evolutionary biology's neglect of the phenotype.

Evolutionary biology has neglected the phenotype because, with the addition of genetics, population genetics, and demography to the theory of adaptation by natural selection, evolutionary biologists were able to produce wonderfully elegant and powerfully predictive formal models of how gene pools behaved. Thus, the focus of evolutionary biology, and especially today's sociobiology, has been almost exclusively on those factors that change the frequency distributions in gene pools from one generation to the next. But in neglecting the phenotype, evolutionary biologists have also neglected the fact that natural selection operates on phenotypes, not genotypes, and that it is the success of the phenotype that determines which genes get copied into the next generation. Perforce, evolutionary biology had also to neglect or oversimplify the ecological interactions of the phenotype with the environment that influence fitness, and to neglect especially the developmental interactions between organism and environment that produce the phenotype (e.g., Stearns, 1982).

There is thus a growing dissatisfaction with models of evolution formulated only in terms of the genotype, especially among biologists, anthropologists, and psychologists concerned with development. The core of life history theory is the notion that the phenotype is a developmental phenomenon—that the relationship of the genotype to the phenotype is a developmental one (of “adaptive indeterminacy,” as Waddington [1968, p. 364] put it).

Life History Theory as Developmental Theory

Life history theory (or the study of life history tactics or strategy) has developed over the past 20 years out of evolutionary biology and ecology and comparative demography. One major concern is with the reciprocal constraints and influences between ontogeny and phylogeny, but it is fundamentally a theory of development because its primary focus is on

how phenotypic traits interact to affect some measure of fitness, i.e., how organisms balance the inherently conflicting evolutionary demands of maximizing reproduction against those of simple survival and the optimal ontogenetic preparation for reproduction (which includes not only physical growth and development and maturation, but also all the varieties of learning). A strong impetus for the development of life history theory was the observation that a number of organisms, including humans, seem to reproduce at rates much lower than they could. If natural selection has designed organisms to maximize fitness, and if fitness is defined as reproductive success (e.g., Daly & Wilson, 1983, p. 21), then why don't all organisms reproduce as much as they can? The answer, of course, stemming largely from Lack's (1954) work, is that frequently total lifetime reproductive output can be maximized by adopting a slow and cautious reproductive strategy which includes high parental investment in a small number of high-quality offspring. Put differently, life history theory does not expect natural selection to maximize reproductive output at the expense of adaptations for survival and optimal patterns of growth and development and learning when these are prerequisites to maximal reproductive success.

Another approach in life history theory is to see life history tactics or strategies as reproductive strategies, i.e., to see development itself as the development of anatomical, physiological, and behavioral phenotypes which serve the ultimate goal of reproduction. Thus, life history traits frequently studied are age at first reproduction, number of offspring, interbirth interval, optimal rates and periods of growth, sensitive period or "prepared" learning, and the timing of senescence and death. Studies of life history have frequently focused on determining the optimal allocation of scarce resources between growth and reproduc-

TABLE 3.1. General characteristics of *r*- and *K*-selected species.

<i>r</i> -selected	<i>K</i> -selected
Variable or uncertain environment	More constant or predictable environment
Recolonization of empty niches	Constant occupation of same niche
Mortality rates often catastrophic, nondirected	Mortality rates steadier, more directed
Variability in population size	Stability in population size
Little intraspecific competition	Keen intraspecific competition
Many offspring	Few offspring
Low parental investment	High parental investment
Small body size	Large body size
Short birth interval	Long birth interval
Rapid development	Slow development
Early reproduction	Delayed reproduction
Short lifespan	Long lifespan
Social behavior often simple or weak	Social behavior often complex
Little or no play	More play

tion, reproduction and survival, growth and differentiation, and mating effort and parenting effort (Daly & Wilson, 1983; Stearns, 1982). Life history theory, however, is not limited to the study of the development of reproductive strategies. Because it is most generally concerned with the tradeoffs between the various components of fitness—at any age—it is relevant to any developmental stage. Life history theory is likely to help us understand better the causes of development because it provides an evolutionary rationale for predicting developmental patterns on the basis of how socioecological factors affect these different components of fitness.

r- and *K*-Selection

The best-known contribution of life history theory is the way it has begun to organize the variety of lifespan developmental patterns seen in both plants and animals. The concepts of *r*- and *K*-selection (Table 3.1) have been developed by a number of theorists (e.g., Gadgil & Bossert, 1970; Horn & Rubenstein, 1984; MacArthur, 1962; MacArthur & Wilson, 1967; Pianka, 1970; Stearns, 1976, 1977, 1982), but they go back ultimately to Dobzhansky (1950), who observed that organisms differ systematically in the degree to which their survival is a direct function of their phenotypes. In unpredictable environments, for example, there are often catastrophic mortality rates in which large numbers die, not so much because they are unfit but because they are unlucky. When selection is thus so undirected it cannot work to produce a more efficient phenotype. Instead, it works to produce a reproductive strategy based on rapid and massive reproduction. The evolutionary payoff under conditions of *r*-selection is that those individuals who reproduce most rapidly, and/or in the greatest number, are disproportionately represented in future generations by virtue of their headstart in filling available niche space.

On the other hand, as an adaptation to the higher levels of intraspecific competition that is characteristic of populations at carrying capacity in more constant, predictable environments, the essence of the *K*-strategy is to ensure reproduction at replacement level. Because there is no payoff in large numbers of offspring in rapid succession (for this would intensify already high rates of intraspecific competition), *K*-selection works to lower reproductive rate and increase efficiency in the exploitation of scarce resources.¹

¹While Horn and Rubenstein (1984), Southward et al. (1974), and Stearns (1976), among others, have criticized *r*- and *K*-theory on the grounds that *K*-selected organisms may have dispersal patterns that favor some *r*-traits, and that high or unpredictable juvenile mortality may select for the *K*-complex as well as the conditions obtaining in populations at carrying capacity in a stable environment, the *r*- and *K*-complexes themselves are still regarded as accurate, and useful, empirical generalizations (e.g., Daly & Wilson, 1983).

The Evolution of Adaptability

A valid quick conceptualization of *K*-selection is “fewer and better offspring.” The usual interpretation of “better” is more efficient exploitation of scarce resources, but another, more encompassing interpretation is “more adaptable.” By “adaptability” I mean the capacity of an organism to make a successful response to perturbations in its socioecological surround such that the *next time* it encounters that same perturbation, or one sufficiently similar, it can respond with less cost (see Slobodkin & Rapoport, 1974 and Chisholm, 1983 for further discussion of adaptation and adaptability). Cost can be generally defined as time, energy, and resources expended in responding to some environmental stressor, but in the developmental context of life history theory we are especially interested in how these costs of responding to stressors may affect the developing organism’s survival, optimal growth and development, and ultimate reproductive value. Thus, from the perspective of life history theory, one component of adaptability might be thought of as “developmental environmental tracking,” and another as “buffering” against the developmental environment. In either case the outcome is an increased probability that the organism will develop the optimum phenotype in a variety of developmental environments.

K-selection seems to achieve greater developmental adaptability—more finely tuned developmental environmental tracking and buffering systems—through selection for prolonged development. In turn, according to theory (e.g., Bonner, 1982; Gould, 1977; King & Wilson, 1975), prolonged development (or delayed sexual maturation) seems to be achieved through selection for regulator genes which delay the switching on of structural genes which code for the production of endocrine substances (e.g., growth hormone, nerve growth factor) which are the proximate determinants of the timing of onset, the rate, and the period of physical growth and development. In simple terms, in *K*-selective environments prolonged development tends to increase adaptability—and fitness—because with longer periods of infant and juvenile dependency and delayed sexual maturity, individuals are given more time to learn about their highly competitive and complex environments before they lay their reproductive value on the line.

Epigenesis by Selective Stabilization

Such prolonged development not only provides more time for learning, it may also produce organisms better *able* to learn as well. This is because by retarding the rate of somatic development (and/or extending its period) neural structures may be given more time to grow and differentiate—and to be *affected by* the developmental environment. Consider, for example, Changeux’s (1985) notion of “epigenesis by selective stabilization.” He argues that while the fundamental architecture and

adult number of neurons seem genetically determined and are established before birth, “phenotypic variability” is nonetheless *inherent* in the process of neural development. In his view neural development proceeds by the laying down of redundant and variable synaptic typologies which provide the raw material of epigenesis—the raw material for “neural selection” to favor the preservation or stabilization of those synapses that have functional significance in a particular environment. In a manner reminiscent of Waddington, Changeux also notes that there is a progressive *decrease* in the determining effect of the genotype on the neural phenotype from invertebrates to vertebrates, from lower vertebrates to higher, and from nonhuman primates to humans because of the *indeterminacy* inherent in neural developmental processes:

This phenotypic variability is intrinsic. It is the result of the precise “history” of cell division and migration, of the wandering of the growth cone and its fission, or regressive processes and selective stabilization, which cannot be exactly the same from one individual to another even if they are genetically identical (1985, p. 247).

This greater capacity of the hominid brain to be affected by experience is likely to be a function both of brain size and developmental timing. With *more* developing neurons, any inherent “slippage” between genotype and phenotype may be magnified by virtue of the facilitating or inhibiting effect one developing neuron may have on another. And by prolonging the period of development more *time* is provided for these effects to occur. The result could often be increased adaptability, for epigenesis by selective stabilization constitutes a kind of developmental environmental tracking whereby at least some components of the neural phenotype are determined more *immediately* by its developmental environment than by its genotype. Thus, the brains of rats reared in enriched environments show more dendritic branching and an increased density of synapses over those of controls reared in impoverished environments (Rosenzweig, Bennet, & Diamond, 1972), and recovery of function after accidental and experimental brain lesions is greatest in immature animals (Lynch & Gall, 1979). The adaptive significance of this sort of early neurologic tracking of the developmental environment can be seen clearly in the capacity of an immature precocial animal to imprint on the stimulus configuration that is its mother (e.g., Bateson, 1981) and in the fact that it is difficult or impossible for even normal adults to become truly fluent in a second language after full maturation of the brain at puberty (e.g., Lenneberg, 1967; Walker, 1981).

Play

Further, the effects of the developmental environment on the organism’s adult neural/behavioral phenotype are not random with respect to socioecological or demographic factors, and the organism is not a mere

receptacle for these effects, but instead may seek out the kinds of experiences and environments that have fitness-promoting long-term consequences. Consider, for example, Fagen's (1977, 1982) life-historical analyses of animal play. Fagen argues that animal play has few net immediate benefits for fitness because play must frequently divert energy away from growth and expose the animal to risk. On the other hand, play may have considerable *long-term* fitness benefits, which come from the enhanced behavioral flexibility made possible through the power of play to increase neural interconnectivity. By altering the relationship of the young animal to its developmental environment, play effectively makes that environment an "enriched" one, and because of the long-term neural effects of development in an enriched environment, animals that play as juveniles may show more adaptability through a greater tendency to explore, to switch rapidly between different behavior patterns, and to reverse previous learning and engage in new learning. Fagen concludes that higher-order taxonomic differences in play are due primarily to differences in survivorship. In energetically-inefficient species, where there is an adaptive premium on rapid attainment of adult body size (as among most *r*-selected small animals with high metabolic rate) the costs of diverting energy from growth to play selects against the motivation to play. Among larger, more energetically-efficient *K*-selected animals, however, with lower metabolic rates and typically higher survivorship, the costs of diverting energy from growth to play are lower. And with higher survivorship, especially among juveniles, and longer lives, *K*-selected animals are more likely to live long enough to reap the long-term benefits of play.

Lower-order differences in play seem due, however, to differences in the availability of energy and the animal's capacity to efficiently use it. Thus, play is facultatively suppressed in animals otherwise expected to show it when their chances of living long enough to reap its benefits are compromised—by, for example, disease, starvation, a particularly harsh environment, or even a stressful social environment. Horn and Rubenstein (1984) make a similar point when they argue on theoretical grounds that "behavioral decisions about life history" (i.e., phenotypic plasticity in behavior) should occur most frequently in large animals with low reproductive output who are in good condition with large amounts of stored nutrients. This is because *being* in good condition and *having* large amounts of stored nutrients are reasonable indicators of future survival and thus the capacity to benefit from the long-term benefits of the enrichment effects of play.

Fagen's work provides us with an example of how we can better understand the causes of development by focusing on the socioecological factors affecting the fitness costs and benefits associated with different developmental patterns. With respect to play, his overall conclusion is

that when the environment varies so as to produce a *succession* of novel selective forces, development should show continuous phenotypic plasticity and play should evolve to have a general effect on behavioral flexibility. One environment in which a succession of novel selective forces is virtually guaranteed is a social environment in which individuals learn and are surrounded by others who also learn and who continuously generate novel behavioral strategies. Such, of course, is a good characterization of the social environment of hominid evolution, at least since the end of the Pleistocene, when our anatomically modern ancestors spread over the globe and adjusted their subsistence activities, work loads, sexual division of labor, economies, social organizations, and especially their patterns of mating and reproductive effort to suit local conditions. Because of increased parental investment, especially male parental investment, hominid evolution was probably also characterized by increased juvenile survivorship (Lancaster & Lancaster, 1983), which would further increase the payoff from phenotypic plasticity in behavioral development.

In this context of the evolutionary ecology of animal play and the possible long-term adaptive consequences of behavioral flexibility through play, it is interesting to note that play, virtually by definition, involves some form of exploration of the physical and social environment, and that the maturation of fearful responses almost universally inhibits such play or exploration. Thus, one avenue toward increased play-exploration and its long-term consequences for fitness might be selection for the delayed onset of these fearful responses. Consider the recent work of Belyaev and his colleagues (1985) in Russia: Investigating the physiological mechanisms underlying animal domestication, they observed developmental patterns in two strains of silver fox pups. One strain was an unselected control group while the other had been subject to 25 years of artificial selection for "tameness" (e.g., ease of handling and low levels of aggression toward handlers). They found that pups from the "tame" strain had significantly *longer* "periods of primary socialization," i.e., they were significantly delayed in the first appearance of fearful responses. In other words, selection for "tameness" resulted in less aggressive animals because those animals who showed a longer sensitive period of primary socialization had more time to explore their environments and to establish more firmly the habit of positive approach toward their handlers before they developed fearful responses toward them. It might be revealing for developmental neurobiologists to replicate this study and investigate the possibility that simply with more *time* for positive approach interactions with the environment before the maturation of fear the neural pathways mediating such positive approach behaviors were more functionally validated and thus less likely to be extinguished or atrophy from insufficient use when fearful behaviors began to emerge.

The Baldwin Effect and Genetic Assimilation

An important theoretical consequence of natural selection for phenotypic plasticity is that when the later effects of early experience include some selective advantage what may be actually selected for is some new pattern of development. While we are beginning to understand how phylogeny affects ontogeny, it is important to appreciate that ontogeny (including developmental experiences) can also affect phylogeny—and that this does not involve Lamarckian inheritance.

One process whereby experience (including the early experience made possible by phenotypic plasticity) can affect evolution is the Baldwin Effect (Baldwin, 1896). In its general form the Baldwin Effect describes how the capacity of an organism to respond behaviorally to some environmental perturbation may engender novel selection pressures that make the performance of that behavior easier, quicker, or in any way less costly—provided, of course, that the behavior was adaptive (or “successful” in Slobodkin and Rapoport’s [1974] terms). The standard example is of a hypothetical ungulate who meets a novel predator and responds behaviorally by running away. This immediate, flexible, low-stake behavioral response, if called into play sufficiently often, focuses selection on those aspects of the animal’s anatomy and physiology that make fleeing more efficient. Thus, over generations, behavior can engender natural selection for the development of anatomical structures and physiological processes that make the expression of the behavior more likely or its performance less costly.

For an example of how early experience specifically may engender novel selection pressures consider the example of silver fox development cited above. Here, apparently because of normal variation in the age of onset of fearful responses, silver fox pups who had a late onset of fearful responses had a longer period of time to engage in positive, nonfearful interactions with their handlers. This early experience had the later effect of making them less aggressive toward their handlers, and as a result, their handlers bred them with other tame foxes. Over 25 years such artificial selection resulted in a strain of foxes where an altered pattern of life history—the longer sensitive period of primary socialization—made it more likely that descendant pups would have the kind or amount of early experience that provided the basis for low levels of adult aggression. The fact that selection was artificial in this example is, of course, irrelevant to the Baldwin Effect concept; if silver fox adults with low levels of aggression were to prefer mates with similarly low levels of aggression in the wild then natural selection would achieve the same result.

Another process whereby early ontogenetic experience may affect phylogeny is that of genetic assimilation. In Waddington’s (1953) classic

experiments fruit fly pupae were subjected to heat stress (the early experience) and a sizeable proportion subsequently failed to develop normal cross-veins on their wings (the later effect). In his experiments this later effect can be considered adaptive, for flies with this trait were allowed to breed. Waddington then subjected all but a few of their offspring to the same heat stress, for many generations. After 14 generations some flies began to appear without cross-veins (the later effect) *even without* the experimental early experience of heat stress, and as Waddington continued the selection process the number doing so without early heat stress also rose. This is not, as it may first appear, Lamarckian inheritance. Waddington argued that in each generation he had exerted selection for those genes making a difference in how easily the flies developed without cross-veins. Thus, as in the Baldwin Effect, when the later effects of some early experience include some fitness benefit, what seems to be selected is the capacity to more readily or easily develop the trait—morphological or behavioral—that provides the fitness benefits.

Genetic assimilation and the Baldwin Effect are both means whereby ontogenetic experience may affect phylogeny, but they are not identical processes (Bateson, 1982). In the Baldwin Effect, when behavior is sufficiently plastic an environmental change may elicit a novel behavior or confer a selective advantage on a behavior that was earlier neutral or irrelevant. When such a behavior increases fitness its very success engenders novel selective pressures affecting a range of morphological, physiological, or other behavioral traits perhaps even only indirectly associated with it (e.g., selection for more efficient hemoglobin in an animal whose novel behavior is flight from a predator). In genetic assimilation, however, the adaptive trait need not be a behavior, and whether it is behavioral or strictly morphological, it is the animal's capacity to more readily or efficiently *develop* the trait that seems to be rather narrowly selected. Waddington argued that genetic assimilation will occur when an environmentally induced trait increases fitness—and as a result the appearance of that trait in subsequent generations exposed to the same environment will depend increasingly less on the environment. Control of the trait is then said to have been assimilated to the genotype from the phenotype-environment interaction.

While the Baldwin Effect seems to operate by the straightforward manner in which the adaptive novel behavior simply exposes the animal's morphology and physiology to novel selective forces, the picture is less clear for what happens in genetic assimilation. Waddington suggested that in the initial stages of genetic assimilation what might be selected for is an increased sensitivity by the developing animal to the environmental stimuli that induced development of the adaptive trait; clearly, the capacity of the animal to be affected by the environ-

ment in that manner had to reside in its genotype in the first place, even if it had never been specifically favored by selection (see also Stearns, 1982). Thus, according to Waddington's thinking, when an animal has the capacity to be affected by the environment in such a way that the trait that appears as a result increases the animal's fitness, then selection will favor an increase in the capacity to be thus adaptively affected by the environment. The animal's threshold for responding to the environmental influence will be lowered to the point where it is so sensitive to the particular influence that the environment begins to serve as a simple trigger for the trait's appearance. Waddington supposed further that in later stages of genetic assimilation any genetic mutation which took over this trigger function from the environment would have a selective advantage.

To summarize, under certain conditions *K*-selection and neoteny may conspire to produce "better" offspring through selection for ontogenetic mechanisms (like epigenesis by selective stabilization) that enable the developing organism to be adaptively affected by its developmental environment. The capacity of an organism to be so affected clearly resides in its genotype, but any positive effects on the organism's fitness as a result of this capacity depend most immediately on the nature of the developmental environment. When this environment is sufficiently constant for enough generations, furthermore, the fitness-enhancing effects of the early experience may also feed back to the genotype, through the Baldwin Effect or genetic assimilation, making the ontogenetic appearance of the adaptive trait *less* dependent on the developmental environment. Such a process, as Waddington saw, depends on an "essential indeterminacy" (1968, p. 364) in the ontogenetic effect of the genotype on the phenotype. This view of natural selection for adaptability is also the essence of Slobodkin and Rapoport's (1974) notion of an "optimal strategy of evolution": "It is not necessary for the genotype to contain a complete, detailed set of directions for the development of a particular feature if the environment itself can contribute information to the developing organism" (1974, p. 198).

Bonner (1980, 1982), Gould (1977, 1982), Bateson (1976, 1982), Plotkin and Odling-Smee (1979, 1981) and others have made similar points about the evolution of adaptability, the effect of the genotype on the phenotype, and the relationships between ontogeny and phylogeny. And interestingly enough, for he considerably antedates the recent concern with these issues and is identified for his concern with the genotype much more than the phenotype, Sewall Wright held the view that "[phenotypic plasticity] is not only of the greatest significance as a factor in evolution in damping the effects of selection . . . but is itself perhaps the *chief object* of selection (1931; quoted in Stearns, 1982, p. 240, emphasis added).

Plasticity and Canalization: Uncoupling the Phenotype from the Genotype

Here I explore in more detail the concepts of phenotypic plasticity and canalization, for both are processes for uncoupling the phenotype from the genotype and deal, respectively, with developmental environmental tracking and buffering. Further, evolutionary ecologists interested in development have begun to characterize the socioecological and demographic conditions under which each is expected. While considerable terminological and conceptual confusion still surrounds the notions of phenotypic plasticity and canalization, they are nonetheless becoming an integral part of life history theory, and they promise to help us generate ecologically valid developmental models.

Stearns (1982) has provided a summary of the most up-to-date thinking on phenotypic plasticity and canalization and their relevance for life history theory. He defines phenotypic plasticity as the capacity of a single genotype to produce a wide range of environment-dependent phenotypes. Phenotypic plasticity provides an adaptive advantage when the fitness of the phenotype is more immediately determined by its developmental environment than by its genotype, which might otherwise be suboptimal. That is, through such environmental effects as maintenance, facilitation, and induction (Gottlieb, 1976; see also Aslin, 1985) the phenotype achieves greater fitness than it would without such a capacity to be affected by the environment. The range of phenotypes permitted by a genotype with the capacity for phenotypic plasticity may be wide, but the adaptive significance of phenotypic plasticity comes not from the width, per se, of this range but from the phenotype's ability to *track* its developmental environment, to be affected by it in ways that promote fitness.

Canalization, on the other hand, is the capacity of a wide range of genotypes to produce the same phenotype, which may be the optimum. Canalization provides a fitness advantage when only one or a narrow range of phenotypes can enjoy any reproductive success. If phenotypic plasticity is a sort of developmental environmental tracking, canalization is a buffering against some aspect of the developmental environment—or against mutation and recombination, which might also endanger development of the optimum phenotype.²

²As one sign of the confusion surrounding the concepts of phenotypic plasticity and canalization, consider their number of synonyms and metaphors: Phenotypic plasticity is also referred to as developmental plasticity, behavioral choices, behavioral flexibility, probabilistic epigenesis, and soft wiring. Waddington, who coined the term *canalization*, also spoke of chreods (fated path) and homeorrhesis. *Homeorrhesis* was used in analogy with *homeostasis*, but

Following Bradshaw (1965), Stearns recognizes three types of phenotypic plasticity: continuous, discrete, and fixed. Of these, continuous and discrete seem most relevant to human development. Continuous phenotypic plasticity describes the type of developmental environmental tracking in which the phenotypic response to the environment (the effect of the environment on the phenotype) is matched or scaled to some feature of the environment with a continuous distribution. Within limits, for example, many organisms will grow as long as food is available, scaling body size to resource availability. Discrete plasticity, on the other hand, describes the type of developmental environmental tracking in which the phenotypic response of the organism is not scaled to some feature of the environment, but instead is *switched* or *triggered* by the environment onto one of two (or some small number of) developmental pathways. In discrete plasticity there are few if any intermediate phenotypes, and all individuals show one or the other of only two (or some small number of) discrete phenotypes. The environmental sex determination of some fish and turtles are good examples (e.g., Charnov, 1982).

THE SOCIOECOLOGY OF UNCOUPLING

Continuous phenotypic plasticity is generally expected when socioecological conditions vary so as to present the individual with a succession of novel environments (i.e., the environment is predictably unpredictable). Under these conditions individuals with a greater capacity for continuous plasticity are more successful in responding to novel conditions. A succession of novel environments is more likely to be encountered at the extreme *K*-selected end of the continuum, where there is likely to be the most crowding, the most intense sociality, and the most competition. When this happens, the fitness consequences of one individual's behavioral strategy depends in great measure on the strategies adopted by all the others (e.g., Dawkins, 1980; Maynard Smith, 1976; Parker, 1984). Continuous plasticity enables individuals to generate conditional strategies in which their own behavior is scaled to that of others (Horn & Rubenstein, 1984). As mentioned, continuous plastic-

with the idea that what was held constant was not a state, but a process—a developmental pathway. The notions of phenotypic elasticity, goal-corrected development, developmental homeostasis, deterministic epigenesis, and equifinality are also encountered as more or less equivalent to canalization. The standard example of canalization in human development is that of catch-up growth after episodes of illness or undernutrition (Prader, Tanner, & von Harnack, 1963), and it has given rise to the notion of behavioral catch-up growth. Together, phenotypic plasticity and canalization are known as alternate developmental pathways, and they may also be discussed under the concept of facultative adaptation.

ity is also expected more in individuals in good condition—the strongest, the healthiest, and those with the most stored resources.³ This is because such individuals are in a better condition to *use* their resources—to allocate them among the conflicting costs attached to the larger number of behavioral options that they make possible. We do not expect, in other words, as much continuous phenotypic plasticity in individuals who cannot afford the price of such plasticity (see Fagen, 1982 and Johnston, 1982 for discussions of the costs and benefits of phenotypic plasticity).

Stearns suggests, on the other hand, that discrete plasticity—the existence of developmental switches—is primarily associated with three conditions: first, when environmental changes are discontinuous rather than continuous; second, when intermediate or graded phenotypes could not occur because of prior developmental constraints; and third, when environments vary more *between* generations than within them, i.e., even if the environmental changes are periodic, their periodicity is greater than the organism's lifespan. Fagen (1982) makes a similar point in arguing that developmental switches should be found in unpredictable environments, but refines the argument by adding that such switches will be especially common when the environment shows unpredictable temporal fluctuations over a predictable set of values. Under these conditions development should be sufficiently plastic to match the phenotype to the predictable value, but since these predictable values are unvarying while it is their *timing* that is unknown, the appropriate phenotype should be “rigidly” dependent on any reliable cue about the approaching environmental change. Figure 3.1 provides a schematic representation of continuous and discrete phenotypic plasticity and canalization.

Phenotypic Plasticity and Canalization in Human Development

While not always named as such, the concepts of phenotypic plasticity and canalization have recently begun to appear in models of human development that take seriously the propositions of life history theory and recognize the interplay of evolutionary biological and ecological

³Note that resources may be stored in an individual's body, in the form of fat, and they may be stored in the physical environment, in the form of an individual's control over some territory. Note too, however, that resources may also be stored in the social environment, in the form of nepotism from kin and reciprocal obligations from nonkin. Finally, for humans at least, resources may also be stored in the cultural environment, in the form of, say, banks, or more generally, traditions and laws of ownership, access, and privilege.

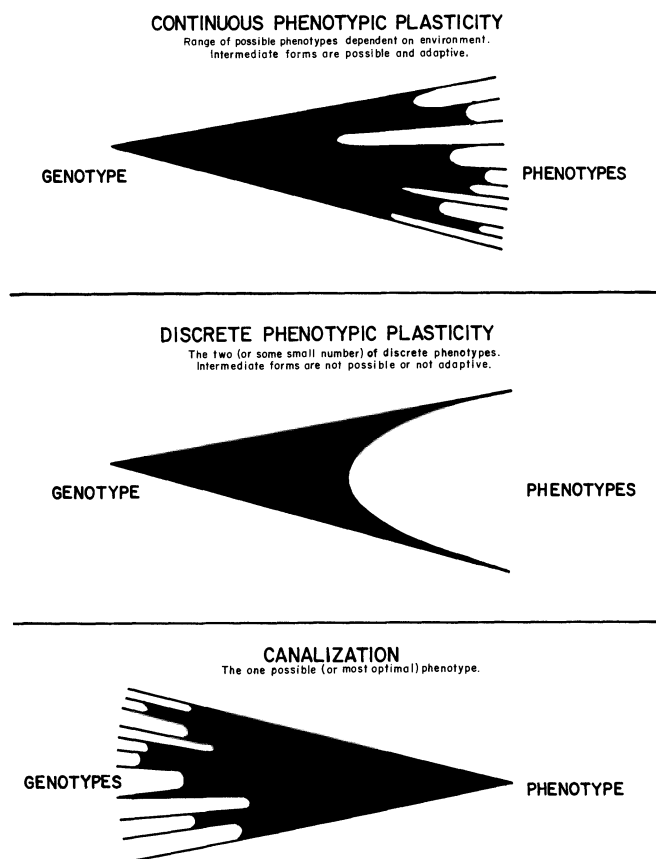


FIGURE 3.1.

factors with ontogeny. One set of such models deals generally with the perennial problem in development of whether or not, how, when, and why early experience affects later behavior. Another set deals with the more specific question of the development of alternate reproductive strategies in humans. I review below selected examples from each set to briefly illustrate how the life history perspective is suggesting new approaches in the study of human development.

CANALIZATION

The questions about whether, how, when, and why early experience may affect later behavior are persistent ones in developmental psychology because it has proven difficult to reliably and convincingly demonstrate such effects. The result is a growing suspicion that simple maturation counts for more in development than early experience (e.g., Kagan,

1980; Kagan, Kearsley, & Zelazo, 1980), that early experience is likely to affect later behavior only when the immediate effects of such experience are supported or maintained by the organism-environment developmental interaction (e.g., Sameroff, 1975), or that early experience is largely irrelevant to later behavior (e.g., Clarke & Clarke, 1976). The concepts of phenotypic plasticity and canalization and the view that ontogeny involves tradeoffs among the components of fitness should help us better understand which early experiences will affect later behavior, under what circumstances, and why.

One approach to these issues suggests that we may, paradoxically, sometimes fail to reliably demonstrate that some early experience affects later behavior precisely because that experience frequently *did* have deleterious long-term fitness consequences in the environment of human evolutionary adaptedness. For example, while attachment theory argues that mutual sensitivity and response-contingency in mother-infant interaction are necessary for the development of secure attachment (e.g., Ainsworth, Blehar, Waters, & Wall, 1978), I have also suggested that precisely *because* secure attachment has been so crucial for the survival and optimal social-emotional and cognitive development of our hominoid ancestors, the development of secure attachment is likely to have been well buffered against socioecological perturbations, i.e., to have been highly canalized, or achieved through a variety of alternate developmental pathways. This suggestion was based on observations of Navajo Indian mother-infant interaction, with the infants both on and off the cradleboard. These naturalistic observations showed, as had experimental studies, that the swaddling effect of the cradleboard reduced infant state and reactivity to stimuli, and that when infants were on the cradleboard, mother-infant interactive bouts were shorter, less intense, and especially, less mutually response-contingent. There was, however, no evidence that these cradleboard effects lasted and no evidence that individual differences in patterns of mother-infant interaction were related to how much each child used the cradleboard. I did not interpret these results as indicating that attachment theory was somehow impoverished. Instead, following Bateson's (1976) arguments about alternate developmental pathways, I suggested that the cradleboard had no long-term effects because the Navajo infants' immediate reaction to the cradleboard (the cradleboard's immediate effects) tended to counteract the cradleboard's potential long-term effects and/or to ensure that the cradleboard was not used enough (however much that might be) for it to have any long-term, potentially negative effects (see Chisholm, 1983 for details of theory, methods, and results). It was, in other words, as if the cradleboard infant was administering his or her own early—or immediate—intervention program to ensure reaching the end point of secure attachment through other means. Or, in

MacDonald's (1986) recent terms, it appeared that the cradleboard babies were able to limit the intensity, frequency, or duration of the cradleboard-related stimuli to within safe limits.

In a similar vein, Main and Weston (1982) have suggested that children who score high on avoidance of mother in the Strange Situation test may simply be following an alternate pathway toward survival and optimal social-emotional and cognitive development under the conditions of living with a rejecting mother. They argue that avoiding a rejecting mother enables these children to preserve a degree of behavioral organization, control, and flexibility they likely would not have if they attempted to maintain proximity to or contact with mother (see also Lamb, Thompson, Gardner, Charnov, & Estes, 1984). Dunn (1976) has made the same kind of argument in more general terms in asking how it could be that attachment research shows so many mothers to be "insensitive" when maternal "sensitivity" is supposed to be so crucial for normal development? LeVine (1977) also speaks to this issue in noting that there are cultural differences in parental goals in child-rearing, and that the relative dearth of "sensitivity," "warmth," and "responsiveness" in mother-infant interaction, qualities so common in our society and emphasized so much by attachment theory, does not obviously lead to functional developmental problems in other societies, particularly those where the primary parental goal is simple child survival.

If we take seriously the idea that developmental processes can affect fitness and that they are exposed to natural selection and evolve, then we should also consider the possibility that selection has favored children who were affected by a *threat* to their development in such a manner that their response to this threat was itself the first step on an alternate developmental pathway to some adaptive end point. We should expect, in other words, on the grounds of life history theory and the comparative socioecology of development, that mechanisms for the canalization of development will be most common when some environmental perturbation poses a threat to an organism's survival, optimal preparation for reproduction, or ultimate reproductive success. We might also expect that early experience which frequently did have negative effects on fitness for our developing hominoid ancestors may *not* so frequently affect our children today—if today's child *can* successfully respond to such early experiences, i.e., if his or her immediate response to the early experience helps to negate or circumvent the threat.

One implication of this perspective for the study of human development is that when we study the effects of early experience on later behavior we should look for the effects *immediately* after the early experience itself, and not after simply arbitrary or convenient intervals. This sort of research design would allow us to determine whether the immediate or short-term effect of the early experience is some response by the child that tends to *prevent* long-term negative fitness effects.

Another implication of this perspective is that our conceptions of pathology might benefit from a reexamination along evolutionary lines. Specifically, I suggest that when we see some child behavior or condition we suspect to be pathological we at least entertain the possibility that what we are seeing might function to increase the child's probability of survival, optimal development, or ultimate reproductive success in his or her particular environment. Canalization seems to imply that some stressor is blocking the child's progress along a preexisting developmental pathway (perhaps the "normal" or "typical" one). In response to this stressor the child shows signs of stress, but without an appreciation of canalization in particular, or an evolutionary perspective on development in general, we might be too inclined to interpret the signs of stress as pathology. We may then miss the possibility that the child is fighting some stressor or embarking on an alternate developmental pathway—in which case the signs of stress would be evidence of healthy adaptation rather than pathology. The work of Main and Weston (1982) just mentioned provides a good example: Children who avoid their mothers may not be showing signs of pathology so much as they are embarking on an alternate developmental pathway which seems likely to have more long-term positive fitness effects than any sort of obligate attachment to a rejecting mother, especially if by avoiding a rejecting mother the child increases his or her chances of finding an alternate attachment figure. If the social environment of hominoid evolution frequently included such alternate attachment figures (aunts, older siblings, grandparents, etc.) this avoidance of a rejecting mother would have been more adaptive in the past than it may be today, at least in our nuclear-family societies, where alternate attachment figures are largely absent.

Rethinking our concepts of developmental pathology in terms of evolutionary ecology and life history theory is no fall from grace into the naturalistic fallacy. The concepts of canalization and alternate developmental strategies suggest the possibility that children's behavior may be adapted to buffer them from socioecological perturbations that were not uncommon during human phylogeny.⁴ They also seem to imply that when children are successful in negating the problem or embarking on a new developmental pathway their behavior is expected to change—with one result being that it is very difficult to demonstrate long-term effects from the perturbing early experience. This is a testable general

⁴The converse is also likely true: children's behavior is not adapted to protect them from developmental perturbations that did not frequently occur during human phylogeny. McKenna (1986) is currently using this argument as a basis for understanding the sudden infant death syndrome (SIDS), which he suggests is related to the evolution of speech, adaptations for speech-breathing, and the likelihood that the environment of human evolutionary adaptedness included virtually constant mother-infant proximity.

hypothesis rather than a statement that pathology does not exist. Pathology obviously exists, and the general prediction may be proved wrong in any particular case. But if it helps us think of new ways to support children in their responses to various classes of early perturbations its usefulness as a developmental model will also be supported (e.g., supporting the *mother* of an avoiding child rather than further stressing the child with treatment for his or her "pathology").

PHENOTYPIC PLASTICITY

On the other hand, when our data show that continuity in development depends on stability and continuity in the developmental environment and the phenotype-environment dialectic, this is precisely what we would expect from continuous phenotypic plasticity. The view of continuous phenotypic plasticity as a sort of developmental environmental tracking suggests that when certain features of the environment show continuity through time, so too will those aspects of behavior that are tracking these environmental features. Environmental continuity also implies continuity in the organism's perceptions of costs and benefits and rewards and punishments and the conditions for relevant learning and practice. Neither continuous nor discrete phenotypic plasticity necessarily entail the notion that the environment acts to somehow simply switch on genes that program for some alternate developmental pathway. Instead, genetic factors are conceived to entail perceptual predispositions contingent on the environment; individuals thus pay more attention to certain aspects of their socioecological surround than to others and, depending on the environment, learn different things.

But which features of the developmental environment should the young organism track? Life history theory suggests that *K*-selected and neotenuous organisms with prolonged development will be sensitive to, or affected by, those aspects of their developmental environment that most affect their survival, optimal development, and ultimate reproductive success. Since it has become apparent that it is less instructive to describe "normal" or "typical" patterns of animal behavior than it is to analyze the costs and benefits of variant behavior patterns according to socioecological factors, the notion of alternate strategies has lately become especially attractive in evolutionary ecology, and, as mentioned above, has appeared in studies of development under all the synonyms for alternate developmental strategies (e.g., Bateson, 1976; Chisholm & Heath, 1987; Hinde, 1984, 1986). Critical tests about the development of alternate *reproductive* strategies, however, are at the forefront of research in evolutionary ecology and life history theory because so little is known about the ontogenetic mechanisms predisposing individuals to adopt one such strategy over another (Partridge & Halliday, 1984). Applying the insights of evolutionary ecology to questions about the

development of alternate reproductive strategies entails the general prediction that organisms will track most closely those aspects of their developmental environments which throughout their phylogenies have provided the most reliable cues to the socioecological conditions they will encounter at reproductive maturity, when they begin to pay the costs associated with mating and parenting.

While the study of the development of alternate reproductive strategies in animals is in its infancy, it has scarcely been born in humans. The midwives for this endeavor in humans are Draper and Harpending (1982, 1987; this vol., Chap. 12) and Lancaster & Lancaster (1983, 1987). Taken together, these authors suggest that for most of human evolution the success of adult reproductive strategies has depended on such general factors as population density; the quality, availability, and predictability of resources; and the sex ratio and availability of mates. Thus, children are expected to be most sensitive to or affected by—to track—those aspects of their developmental environments which have provided the most consistent indicators of the values that each of these variables will have when they become reproductively mature. In addition, as Draper and Harpending (1982) have argued, because sex itself is the universal and most immediate determinant of an individual's reproductive success, children may be adapted to pay particularly close attention to—to track most closely—the sexuality and mating and parenting behaviors they observe in adults around them, for these adults will typically already have committed themselves to a mating and parenting strategy under socioecological conditions which will usually be similar to those the children will also face in only a decade or so.⁵

Draper and Harpending (1982) support these general arguments with an evolutionary, developmental psychological, and cross-cultural reinterpretation of the “absent father syndrome.” They hypothesize that individual and group differences in adult styles and mixes of mating and parenting effort are directly influenced by the presence or absence, during an early sensitive period, of an adult male who is seen to engage in parental investment, either directly in the child, or at least indirectly through his or her mother. They cite considerable evidence consistent with this hypothesis, and argue that human children are adapted to be affected by the presence or absence of an investing male because father presence or absence facilitates *learning* a reproductive strategy that is more likely to be successful in the kinds of socioeconomic environments where fathers are typically present or absent, respectively.

Draper and Harpending (1987) also support these general arguments with an analysis of the different developmental effects of being reared

⁵We may thus have the beginnings of an evolutionary foundation for aspects of Freudian theory, which certainly emphasizes how our early perceptions of sexuality, especially that of our parents, affects our own.

primarily by parents versus being reared primarily by peers, i.e., in “child gangs,” with minimal direct parental care or supervision. The ethnographic literature shows that a “peer care-parent care” continuum exists, and there is evidence of a broad correlation between this continuum and both fertility and mortality (reflecting a mix of mating and parenting effort) and level of sociocultural complexity. “Parent care” societies tend to show low fertility and mortality and to be either hunting-gathering or modern industrial societies, while “peer care” societies show higher fertility and mortality and tend to be found most often among middle-range peasant agricultural and emerging third-world societies. Draper and Harpending postulate that the long-term developmental effects of parent care versus peer care include adult mating and/or parenting behaviors: They suggest that parent-reared children grow up to see that resources are relatively scarce—contingent on their parents’ efforts and on their own capacities to elicit parental investment—and that adults with these perceptions may tend to view their own reproductive and parenting behaviors in this same light. These perceptions then lead to a more conservative, “*K*-like” reproductive strategy. On the other hand, children who spend more time in “child gangs” grow up to perceive that resources are contingent on the size of their social networks and on their own abilities to dominate, manipulate, cajole, and bargain with members of these networks. These perceptions, in adults, lead to a less conservative, more “*r*-like” reproductive strategy, in which children are valued both as laborers and as a sort of “social money in the bank,” for paying and incurring social, economic, and political debts. Draper and Harpending argue that children may be adapted to be differentially affected by parent care and peer care because what children learn under each condition tends to increase total lifetime reproductive success in the socioecological conditions that generated each of the developmental environments in the first place. Lancaster and Lancaster (1983, 1987) follow a similar line of reasoning, but focus more on the predictability of resources than on parent care and peer care per se. In parent-care societies, they argue, resources are seen as more limited, but predictable, and reproductive output is scaled to this perception. In peer-care societies, however, resources are seen as less contingent on one’s own behavior and more contingent on the social milieu. With resources seen as less predictable, the optimum reproductive strategy is perceived to be the “*r*-strategy” of maximum mating effort (and thus less parenting effort), in hopes that some offspring will survive.

Conclusions

The essence of sociobiology is the concept of inclusive fitness, but this concept is an inadequate basis for a natural science of human behavior because it is silent on the process of development. It is the phenotype

that is selected, and it is the success of the phenotype that determines which genes are copied into the next generation. What we need now, as Stearns puts it, is a "developmental evolutionary ecology" (1982, p. 254), because, especially for humans, the relationship of the genotype to the phenotype is a developmental one of tradeoffs among the components of fitness, of phenotype-environment dialectical contingencies and constraints, and adaptive indeterminacy.

Acknowledgments. My thinking about life history theory and human developmental evolutionary ecology has been stimulated and frequently improved in discussions with Nick Blurton Jones, V.K. Burbank, Pat Draper, Henry Harpending, Robert Hinde, Hillard Kaplan, Jane Lancaster, and Jim McKenna. I am also indebted to Steven Stearns (1982) for his felicitous phrase, "developmental evolutionary ecology," which I have borrowed for my title. Portions of this chapter are based on a paper delivered at a conference on the Causes of Development: Interdisciplinary Perspectives at the University of Stirling, Scotland, in June 1986.

REFERENCES

- Ainsworth, M.D.S., Blehar, M.C., Waters, E., and Wall, S. (1978). *Patterns of attachment: A psychological study of the Strange Situation*. Hillsdale, NJ: Lawrence Erlbaum Associates.
- Aslin, R. (1985). Effects of experience on sensory and perceptual development: Implications for infant cognition. In J. Mehler & R. Fox (Eds.), *Neonate cognition: Beyond the blooming buzzing confusion*. Hillsdale, NJ: Lawrence Erlbaum Associates.
- Baldwin, J.M. (1896). A new factor in evolution. *American Naturalist*, 30:441-451.
- Bateson, P.P.G. (1976). Rules and reciprocity in behavioural development. In P.P.G. Bateson & R.A. Hinde (Eds.), *Growing points in ethology*. Cambridge: Cambridge University Press.
- Bateson, P.P.G. (1981). Control of sensitivity to the environment during development. In K. Immelmann, G.W. Barlow, L. Petrinovich, & M. Main (Eds.), *Behavioural development*. Cambridge: Cambridge University Press.
- Bateson, P.P.G. (1982). Behavioural development and evolutionary processes. In King's College Sociobiology Study Group, Cambridge, *Current problems in sociobiology*. Cambridge: Cambridge University Press.
- Belyaev, D.K., Plyusnina, I.Z., & Trut, L.N. (1985). Domestication in the silver fox (*Vulpes fulvus* DESM): Changes in physiological boundaries of the sensitive period of primary socialization. *Applied Animal Behavior Science*, 13:359-370.
- Bonner, J.T. (1980). *The evolution of culture in animals*. Princeton: Princeton University Press.
- Bonner, J.T. (Ed.). (1982). *Evolution and development*. Dahlem Konferenzen. New York: Springer-Verlag.

- Bradshaw, A.D. (1965). Evolutionary significance of phenotypic plasticity in plants. *Advances in Genetics*, 13:115-155.
- Changeux, J.-P. (1985). *Neuronal man*. New York: Pantheon.
- Charnov, E. (1982). *The theory of sex allocation*. Princeton: Princeton University Press.
- Chisholm, J.S. (1983). *Navajo infancy: An ethological study of child development*. New York: Aldine Publishing Co.
- Chisholm, J.S., & Heath, G.D. (1987). Evolution and pregnancy: A biosocial view of prenatal influences. In C.M. Super & S. Harkness (Eds.), *The role of culture in developmental disorder*. New York: Academic Press.
- Clarke, A.M., & Clarke, A.D.B. (Eds.). (1976). *Early experience: Myth and evidence*. New York: Free Press.
- Daly, M., & Wilson, M. (1983). *Sex, evolution, and behavior* (2nd ed.). Boston: Willard Grant Press.
- Dawkins, R. (1980). Good strategy or evolutionarily stable strategy? In G.W. Barlow & J. Silverberg (Eds.), *Sociobiology: Beyond nature/nurture?* Boulder, CO: Westview Press for the American Association for the Advancement of Science.
- Dobzhansky, T. (1950). Evolution in the tropics. *American Scientist*, 38:209-221.
- Draper, P., & Harpending, H. (1982). Father absence and reproductive strategy: An evolutionary perspective. *Journal of Anthropological Research*, 38:225-273.
- Draper, P., & Harpending, H. (1987). Parent investment and the child's environment. In J.B. Lancaster, A.S. Rossi, J. Altmann, & L.R. Sherrod (Eds.), *Parenting across the life span: Biosocial dimensions*. New York: Aldine Publishing Co.
- Dunn, J. (1976). How far do early experiences in mother-infant relations affect later development? In P.P.G. Bateson & R.A. Hinde (Eds.), *Growing points in ethology*. Cambridge: Cambridge University Press.
- Fagen, R. (1977). Selection for optimal age-dependent schedules of play behavior. *American Naturalist*, 111:395-414.
- Fagen, R. (1982). Evolutionary issues in the development of behavioral flexibility. In P.P.G. Bateson & P. Klopfer (Eds.), *Perspectives in ethology* (Vol. 5). New York: Plenum.
- Gadgil, M., & Bossert, W.H. (1970). Life historical consequences of natural selection. *American Naturalist*, 104:1-24.
- Gottlieb, G. (1976). The roles of experience in the development of behavior and the nervous system. In G. Gottlieb (Ed.), *Neural and behavioral specificity: Studies on the development of behavior and the nervous system* (Vol. 3). New York: Academic Press.
- Gould, S.J. (1977). *Ontogeny and phylogeny*. Cambridge, MA: Harvard University Press.
- Gould, S.J. (1982). Change in developmental timing as a mechanism of macroevolution. In J.T. Bonner (Ed.), *Evolution and development*. Dahlem Konferenzen. New York: Springer-Verlag.
- Hinde, R.A. (1984). Biological bases of the mother-child relationship. In J.D. Call, E. Galenson, & R.L. Tyson (Eds.), *Frontiers of infant psychiatry*. New York: Basic Books.
- Hinde, R.A. (1986, June). *Causes of social development from the perspective of an integrated developmental science*. Paper presented at a conference on the

- Causes of Development: Interdisciplinary Perspectives, University of Stirling, Scotland.
- Horn, H.S. & Rubenstein, D.J. (1984). Behavioural adaptations and life history. In J.R. Krebs & N.B. Davies (Eds.), *Behavioural ecology: An evolutionary approach*. Oxford: Blackwell Scientific Publications.
- Johnston, T.D. (1982). Selective costs and benefits in the evolution of learning. In J.S. Rosenblatt, R.A. Hinde, C. Beer, & M-C. Busnel (Eds.), *Advances in the study of behavior* (Vol. 12). New York: Academic Press.
- Kagan, J. (1980). Perspectives on continuity. In O.G. Brim & J. Kagan (Eds.), *Constancy and change in human development*. Cambridge, MA: Harvard University Press.
- Kagan, J., Kearsley, R.B., & Zelazo, P. (1980). *Infancy: Its place in human development*. Cambridge, MA: Harvard University Press.
- King, M.C., & Wilson, A.C. (1975). Evolution at two levels in humans and chimpanzees. *Science*, 188:107–116.
- Lack, D. (1954). *The natural regulation of animal numbers*. Oxford: Oxford University Press.
- Lamb, M.E., Thompson, R.A., Gardner, W.P., Charnov, E.L. and Estes, D. (1984). Security of infantile attachment as assessed in the "strange situation": Its study and biological interpretation. *The Behavioral and Brain Sciences*, 7:127–171.
- Lancaster, J.B., & Lancaster, C.S. (1983). Parental investment: The hominid adaptation. In D.J. Ortner (Ed.), *How humans adapt: A biocultural odyssey*. Washington, DC: Smithsonian Institution Press.
- Lancaster, J.B., & Lancaster, C.S. (1987). The watershed: Change in parental-investment and family-formation strategies in the course of human evolution. In J.B. Lancaster, A.S. Rossi, J. Altmann, & L.R. Sherrod (Eds.), *Parenting across the lifespan: Biosocial dimensions*. New York: Aldine Publishing Co.
- Lenneberg, E.H. (1967). *Biological foundations of language*. New York: John Wiley.
- LeVine, R.A. (1977). Child-rearing as cultural adaptation. In P.H. Leiderman, S.R. Tulkin, & A. Rosenfeld (Eds.), *Culture and infancy: Variations in the human experience*. New York: Academic Press.
- Lynch, G., & Gall, C. (1979). Organization and reorganization of the brain: Evolving concepts of brain plasticity. In F. Falkner & J. Tanner (Eds.), *Human Growth: Vol. 3. Neurobiology and nutrition*. New York: Plenum Press.
- MacArthur, R.H. (1962). Some generalized theorems of natural selection. *Proceedings of the National Academy of Sciences*, 48:1893–1897.
- MacArthur, R.H., & Wilson, E.O. (1967). *The principles of island biogeography*. Princeton: Princeton University Press.
- MacDonald, K. (1986). Early experience, relative plasticity, and cognitive development. *Journal of Applied Developmental Psychology*, 7:101–124.
- Main, M., & Weston, D.R. (1982). Avoidance of the attachment figure in infancy: Descriptions and interpretations. In C.M. Parkes & J. Stevenson-Hinde (Eds.), *The place of attachment in human behavior*. New York: Basic Books.
- Maynard Smith, J. (1976). Evolution and the theory of games. *American Scientist*, 64:41–45.
- McKenna, J. (1986). An anthropological perspective on the sudden infant death syndrome: The role of parental breathing cues and speech breathing adaptations. *Medical Anthropology*, 10:5–50.

- Parker, G.A. (1984). Evolutionarily stable strategies. In J.R. Krebs & N.B. Davies (Eds.), *Behavioural ecology: An evolutionary approach*. Oxford: Blackwell Scientific Publications.
- Partridge, L., & Halliday, T. (1984). Mating patterns and mate choice. In J.R. Krebs & N.B. Davies (Eds.), *Behavioural ecology: An evolutionary approach*. Oxford: Blackwell Scientific Publications.
- Pianka, E.R. (1970). On *r*- and *K*-selection. *American Naturalist*, 104:592-597.
- Plotkin, H.C., & Odling-Smee, F.J. (1979). Learning, change, and evolution. *Advances in the Study of Behavior*, 10:1-41.
- Plotkin, H.C., & Odling-Smee, F.J. (1981). A multiple-level model of evolution and its implications for sociobiology. *The Behavioral and Brain Sciences*, 4:225-268.
- Prader, A., Tanner, J., & von Harnack, G. (1963). Catch-up growth following illness or starvation. *Journal of Pediatrics*, 62:646-659.
- Rosenzweig, M.R., Bennet, E., & Diamond, M.C. (1972). Brain changes in response to experience. *Scientific American*, 226:22-29.
- Sameroff, A.J. (1975). Early influences on development: Fact or fancy? *Merrill-Palmer Quarterly*, 21:267-294.
- Slobodkin, L., & Rapoport, A. (1974). An optimal strategy of evolution. *Quarterly Review of Biology*, 49:181-200.
- Southwood, T.R.E., May, R.M., Hassell, M.P., & Conway, G.R. (1974). Ecological strategies and population parameters. *American Naturalist*, 108:791-804.
- Stearns, S.C. (1976). Life history tactics: A review of the ideas. *Quarterly Review of Biology*, 51:3-47.
- Stearns, S.C. (1977). The evolution of life history traits: A critique of the theories and a review of the data. *Annual Review of Ecology and Systematics*, 8:145-171.
- Stearns, S.C. (1982). The role of development in the evolution of life histories. In J.T. Bonner (Ed.), *Evolution and development*. Dahlem Konferenzen. New York: Springer-Verlag.
- Waddington, C.H. (1953). Genetic assimilation of an acquired character. *Evolution*, 7:118-126.
- Waddington, C.H. (1968). The theory of evolution today. In A. Koestler and R. Smythies (Eds.), *Beyond reductionism*. New York: Macmillan.
- Walker, L.C. (1981). The ontogeny of the neural substrate for language. *Journal of Human Evolution*, 10:429-441.
- Wright, S. (1931). Evolution in Mendelian populations. *Genetics*, 16:97-159.

Part II

The Domains of Children's
Behavior: The Self, Moral
Development, Altruism,
Aggression, Peer Relations,
and Cognition

4

On the Evolution of Self-Knowledge and Self-Deception

DENNIS KREBS, KATHY DENTON, and NANCY C. HIGGINS

Man's brain, like the rest of him, may be looked upon as a bundle of adaptations. But what it is adapted to has never been self-evident. We are anything but a mechanism set up to perceive the truth for its own sake. Rather, we have evolved a nervous system that acts in the interest of our gonads, and one attuned to the demands of reproductive competition. If fools are more prolific than wise men, then to that degree folly will be favored by selection. And if ignorance aids in obtaining a mate, then men and women will tend to be ignorant. In order for so imperfect an instrument as a human brain to perceive the world as it really is, a great deal of self-discipline must be imposed.

Michael T. Ghiselin

"Know yourself" is one of the most ancient of all injunctions. Although some primates possess the ability to recognize their own faces, and therefore must possess a rudimentary sense of self (Gallup, 1977), humans appear to be unique among animals in their ability to know themselves. What is the nature of this ability? How did it evolve, and why? How effective are the processes through which people acquire self-knowledge, and how valid are the products—people's conceptions of themselves? At the risk of spoiling the story by telling its end, we will conclude that it often is maladaptive to perceive oneself accurately, that the processes of self-conception are biased in self-serving ways, and that people are at least as adept at self-deception as they are at self-perception.

The fundamental assumption of evolutionary theory is that genetically mediated variations among individuals that enhance their reproductive fitness will be selected and, over time, define the nature of their species. The central contribution of sociobiology has been to extend the construct of reproductive fitness to inclusive fitness (the total representation of replicas of one's genes in the population). The primary question to which an evolutionary perspective gives rise is: What adaptive functions might self-knowledge (and self-deception) have served in the evolution of the human species? Assuming some genetic input into tendencies to know oneself, which individuals would have been most

fit—those who perceived themselves most accurately, those who perceived themselves least accurately, or those who inherited some combination of these tendencies—and why?

We should be clear at the outset that we assume that the central value of the evolutionary perspective to psychology lies in its ability to raise questions and to supply hypothetical models of how things might have been, not to answer the questions or establish the validity of its models. We seek here to summarize existing evolutionary theory and research on self-knowledge, evaluate them, and present an expanded model of our own.

Evolutionary theorists have written relatively little about self-knowledge and self-delusion—not surprising perhaps, in view of the uniquely human quality of the phenomena. However, some sociobiologists have speculated about the adaptive value of deception and self-deception.

Deception

Sociobiologists have derived their position on self-deception through evolutionary analyses of deception. Wallace (1973) was one of the first biologists to emphasize the adaptive value of deception, describing animals who mislead unrelated conspecifics (for example, about the location of food) in order to obtain more resources for themselves. Sociobiologists such as Trivers (1985) recount examples of camouflage, mimicry (e.g., nonpoisonous snakes that evolve to look like poisonous snakes, and males that evolve to look like females), and bluffing that entail false advertisements—plants and animals acquire or adopt physical characteristics or behaviors that cause other organisms to respond to them as though they were something or someone they are not. But are plants that evolve to look like female bees (thereby evoking pollination by male bees who attempt to copulate with them) practicing “deception”? Certainly the plants do not *intend* to mislead the bees. In such cases deception is defined in terms of the behavior of the deceived—acting toward one organism as though it were another.

According to Mitchell (1986) deception occurs when a receiver registers (or believes) information from a sender and behaves toward it as though it were something other than it is, conveying some benefit to the sender. Mitchell (1986) supplies a useful framework for discussing deception, distinguishing among four “levels” (see Table 4.1). Level-one deception involves the firing of fixed programs such as those that cause male bees to copulate with plants that look like female bees. Level-two deception involves conditional responding, such as attack birds that behave as though they are injured. Level-three deception involves learning: birds that learn to sing a variety of songs to create the illusion of a crowded habitat (“Beau Geste” behavior, see Table 4.1) supply an

TABLE 4.1. A Summary of the Levels of Deception:, with Examples

Level	Deception is Effected by	Program	Examples of Deceiver	Examples of Deceived
I	Appearance	"always do p"	Batesian mimics; butterflies with false- head; plants which mimic.	Not possible.
II	Coordination of perception and action	"do p given that q is so"	Firefly femmes fatales; birds which feign injury; angler- fish which darts lure.	Males which respond to femmes fatales fireflies.
III	Learning	"do any p given that p resulted in q in your past"	Birds of Beau Geste hypothe- sis; dog which fakes a broken leg.	Blue jays which respond to Batesian mimicry of butterfly; foxes which respond to injury-feign- ing of birds.
IV	Planning	Self-programmed	Chimp which misleads about location of food; humans who lie.	Humans deceived by verbal lie.

Source: Mitchell, R.W. (1986). A framework for discussing deception. In R.W. Mitchell & N.S. Thompson (Eds.) *Deception*. NY: State University of New York Press, p. 29.

example. Deception at level three may involve an intention (a dog may limp because it wants to be petted), but not the intention to deceive (the dog isn't attempting to mislead its owner). Only at level four, characteristic of humans and some apes, is there intention to deceive.

To intend to deceive, one must possess the cognitive sophistication necessary to anticipate the impression another will form—perspective-taking ability—and the mental acuity to create a false impression. Consider an example described by Menzel (1974). One chimp knew where food was hidden. This "sender" misled a second chimp by behaving in a way that caused the second to believe the food was somewhere else, then she ran back and retrieved the food for herself. According to Menzel, the first chimp knew where the food was, realized certain behaviors would be interpreted by the second chimp as evidence that food was in another direction, and planned to mislead her. The mental abilities that mediate fourth-level deception in humans are revealed in research on perspective-taking tasks such as the 5-cent–10-cent game, where children fool other children by hiding dimes under cups labeled "5 cents" (Flavell et al., 1968).

Sociobiologists such as Alexander (1975) and Trivers (1985) believe that deception is of immense significance in human behavior. Humans respond to appearance—signs of how things are—not reality. According to Alexander (1975), human society is “a network of lies and deception.” In the currency of natural selection, what counts is how others treat you, not why. If manipulation and deception enhanced our ancestors’ fitness better than honesty, they would have been selected; but with a catch. Individuals are receivers as well as senders, so it is in their evolutionary interest to detect and counteract manipulation and deceit. Thus, dispositions that induce individuals to detect, counteract, and punish deception should have evolved with dispositions to deceive, controlling the unmitigated evolution of deception. The product of this process should be a dynamic equilibrium—an evolutionarily stable strategy (Maynard-Smith, 1976) in which deceit and detection exist in optimal balance. Individuals practice deception, employing increasingly sophisticated techniques, but, at the same time, they develop increasingly sophisticated deception detectors. Thus, social interaction is like a giant chess game, with moves and countermoves, with winners (successful deceivers) and losers, and with most games ending in stalemate.

Note, however, that the adaptive value of deception detectors lies in the detection of deception in others, not in oneself. There is less obvious value in detecting one’s own deception, especially if deception is negatively valued (and punished); indeed, it may well be in one’s evolutionary interest to avoid detecting deception in oneself. Campbell (1983) has argued that we inherit genetic programs (“criterion images”) sensitive to the detection of transgressions in others, but insensitive to the detection of transgression in ourselves. This line of thought leads to sociobiological work on self-deception.

Self-Deception

Several sociobiologists have suggested that self-deception has evolved in the human species. Alexander (1975, 1979), Lockard (1980), and Trivers (1972, 1974, 1985) suggest that the primary adaptive function of self-deception is to make individuals better deceivers. “With powers to deceive and to spot deception being improved by natural selection, a new kind of deception may be favored: self-deception. Self-deception renders the deception being practiced unconscious to the practitioner, thereby hiding from other individuals the subtle signs of self-knowledge that may give away the deception being practiced” (Trivers, 1985, p. 395). When individuals are self-deceived, they are unaware of the truth—the truth is known only at an unconscious level. Because they do not display the “shifty eyes, sweaty palms, and croaky voices” (Trivers, 1985,

p. 416) associated with awareness of lying, their lies go undetected and unpunished.

Alexander (1975) explored the implications of self-deception in humans' conceptions of their nature. We are prone to believe we are fair, honest, and altruistic, argues Alexander (1979), when in fact we are deceitful and selfish "because 'sincere' hypocrisy with repressed awareness of own guilt will optimize individuals' inclusive fitness" (cf. Campbell, 1983, p. 30). In summary, from the sociobiological perspective "self-deception is seen as an active, organized process that improves the deception of others" (Trivers, 1985, p. 420).

Most sociobiologists use the term *self-deception* loosely, as roughly equivalent to "false ideas about oneself" (Trivers is an exception). In contrast, philosophers such as Demos (1960) define the construct in a highly specialized way. Although a complex philosophical analysis of self-deception is inappropriate here, note that the notion that individuals deceive themselves is paradoxical. How can the deceiver and the deceived be the same person? By definition, a person cannot be deceived if he or she knows the truth. A deceiver knows the truth, and misrepresents it to the object of deception. If this object is the self, who is the deceiver? The only plausible answer is another part of the self: one part of the self deceives another. The self as deceiver—who knows the truth—must be in some way separated from the self as deceived—who is unaware of the truth. Thus, self-deception implies a divided mind.

According to investigators such as Gur and Sackeim (1979), to deceive themselves individuals must (1) harbor two contradictory beliefs (the truth and the distortion of the truth), (2) hold the beliefs simultaneously, and (3) know one belief consciously and the other unconsciously. These criteria pertain to *how* people deceive themselves. In addition, Gur and Sackeim insist we must make an assumption about *why* people deceive themselves, namely, (4) that self-deception offers some advantage to the individual. In Mitchell's (1986) terms (see Table 4.1), self-deception follows the same pattern as deception (the sender benefits when the receiver incorrectly believes the message is valid), except the sender and receiver are different (unconscious and conscious) parts of the same individual.

Although these four criteria seem sufficient for self-deception as a *product* at the third level described by Mitchell, they do not seem sufficient for self-deception as a fourth-level *process*. Thus, an additional criterion must be added, namely, the *intention to deceive*: an unconscious process must intend to deceive a conscious process.

What evidence is there that individuals deceive themselves? The sociobiological contributions have been largely theoretical, though Lockard (1980) and Trivers (1985) offer some suggestive empirical support. Evidence adduced for self-deception is derived mainly from seven

areas of investigation—concealed ovulation, neurological evidence on divided consciousness, physical expressions of emotion, psychophysiological responses, perceptual defense and subliminal perception, dissociative disorders, and hypnosis. Let us consider each briefly in turn.

CONCEALED OVULATION

According to Alexander and Noonan (1979), and Daniels (1983), concealed ovulation in human females involves both deception and self-deception. Not knowing when they are ovulating enables human females to fool males into investing in them when they are infertile (Alexander & Noonan, 1979) and ensures that their attention is not distracted from basic survival activities (Daniels, 1983). However, as pointed out by Mitchell (1986) concealed ovulation is closer to camouflage than deception; the “self-deception” involved in concealed ovulation is most appropriately termed ignorance. There is no evidence that females *know* in some unconscious part of their minds they are ovulating and keep this information from consciousness.

NEUROLOGICAL EVIDENCE ON DIVIDED CONSCIOUSNESS

Lockard (1980) adduces neurological evidence to support the idea that self-deception is fostered by a “gating” process in the brain through which some information is admitted to consciousness and other information is not. The general thrust of this evidence is that the right and left hemispheres of our brains mediate different types of experience, that individuals may harbor information in each hemisphere simultaneously, and that the information in one hemisphere may be conscious while the information in the other is not. For example, Ojemann (1979) found that electrical stimulation of the ventral lateral thalamus affected access to and retrieval of short-term memories, and that the effects were highly lateralized (stimulation of left thalamic regions affected memory of verbal material; stimulation of right thalamic regions affected memory of visual-spatial material).

Split-brain researchers such as Sperry (1969), and LeDoux, Wilson, and Gazzaniga (1979) have reported evidence of divided consciousness, with knowledge in each hemisphere unavailable to the other (no wonder, with their subjects’ brains cut in half). Split-brain patients have undergone surgery to sever the corpus callosum, the neural pathway mediating the flow of information between the right and left hemispheres of the brain, in order to control severe epilepsy. Research on split-brain patients has revealed that the left and right hemispheres process information in qualitatively different ways and possess qualitatively different forms of knowledge. The left hemisphere processes infor-

mation in a linearly logical, verbal manner, and the right hemisphere processes information in an intuitive, visual-spatial way. In most people the left hemisphere dominates consciousness; knowledge in the right hemisphere is unconscious.

There is evidence that the two hemispheres may mediate contradictory behaviors and that the left hemisphere may misinterpret and distort the knowledge possessed by the right hemisphere. For example, Sperry once observed the right hand of a split-brain patient (controlled by the left hemisphere) who was dressing for an occasion she dreaded buttoning her coat while her left hand (controlled by the right hemisphere) followed behind undoing the buttons! In another demonstration, a nude picture transmitted to the right hemisphere of a split-brain patient, evoked embarrassed laughter, but when asked why, (her verbal left hemisphere) gave a false, socially acceptable reason.

It is possible in normal people that the unconscious right hemisphere, and, probably, unconscious processes in the left hemisphere, give rise to experiences and behaviors that the conscious processes in the left hemisphere misinterpret. According to LeDoux et al., "it is as if the verbal self looks out and sees what the person is doing, and from that knowledge it interprets a reality" (1979, p. 549). The left hemisphere supplies interpretations that best fit the observations, without any (conscious) knowledge of the real causes. LeDoux et al. (1979) have argued that the verbal system ("verbal self") is the predominant "level" of consciousness (sort of like the "tip of the iceberg"); that there are multiple levels of consciousness (or "multiple mental systems"); and that these "multiple mental systems in the brain, each with the capacity to produce behavior, and each with its own impulses for action, are not necessarily conversant internally" (p. 550). According to LeDoux et al. (1979):

The environment has ways of planting hooks in our mind, and while the verbal system may not know the why or what of it all, part of its job is to make sense out of the emotional and other mental systems and in so doing allow man, with his mental complexity, the illusion of a unified self (p. 553).

Split-brain research supplies evidence supporting the first four criteria of self-deception: the existence of contradictory beliefs, held simultaneously, one conscious, the other unconscious, with individuals showing a preference for socially acceptable beliefs. However, no one has yet established that any process in the right hemisphere actively *intends* to deceive any conscious and self-reflective capacity of the left hemisphere (the fifth criterion); rather, the evidence suggests that the left hemisphere misinterprets emotional, cognitive, and behavioral reactions mediated by the right hemisphere—a third-level deception.

FACIAL EXPRESSIONS AND BODY LANGUAGE

Lockard (1980) adduces the results of research on facial expressions of emotion and body language as evidence for self-deception. As Darwin (1872) emphasized, a primary adaptive function of facial expressions and demeanor is to communicate emotional states to others. But it is not always in one's evolutionary interest to communicate one's emotional state accurately, especially if one's intention is to deceive. Therefore, individuals learn to control and manipulate nonverbal channels of communication (Ekman & Friesen, 1974). Further, like the behavioral evidence used by split-brain patients to interpret unconscious thoughts, facial expressions and other forms of nonverbal behavior supply information to individuals about themselves—individuals receive and interpret the information their bodies send. If the aspects of self that send nonverbal expressions (say, right hemisphere processes) are separate from the aspects that receive them (the left hemisphere “interpreter”) or cannot be translated, individuals may reach incorrect conclusions about their emotional states. If one (unconscious) aspect of the self can make the face and body behave as if it is telling the truth, another (conscious) part may interpret this behavior as evidence that one is in fact telling the truth. In support of this idea Werth and Flaherty (1986) found that persuasive liars—those who successfully deceive others—tend to be taken in by their own lies.

PSYCHOPHYSIOLOGICAL RESEARCH

The process of “lie detection” in psychology involves comparing the psychophysiological reactions of people when they are telling the truth and lying. Lying makes most people anxious: they sweat more, their heartrate accelerates, and so on. There are two problems with lie detection—one is that psychophysiological reactions can be induced by stimuli other than lies; the second is that individuals who believe their lies may not emit measurable psychophysiological reactions.

Interestingly, psychophysiological research on self-deception is not based on individuals' reactions to lying; rather it is based on the observation that people emit stronger psychophysiological responses to their own voices than to the voices of others, and that people habituate to others' voices, but not to their own. In what Trivers (1985) characterizes as a brilliant demonstration of self-deception, Gur and Sackeim (1979) exposed some subjects to an experience of success (doing well on an intelligence test) and some subjects to an experience of failure (doing poorly). The investigators reasoned that success would motivate individuals to, in a sense, be full of themselves and therefore to be disposed to identify others' voices as their own (to utter false positives on a voice recognition task at a conscious level of awareness). In contrast, they expected sub-

jects who failed, in effect, to diminish themselves and to utter false negatives—incorrectly identifying their voice as another's. In Gur and Sackeim's words: "When people are made to feel good about themselves, they tend to project and see themselves in places where they are not. When people are made to feel bad about themselves they tend to deny seeing themselves in places where they are" (1979, p. 165). Gur and Sackeim employed two measures of voice identification—a verbal one, revealing subject's conscious beliefs, and a psychophysiological one, revealing subjects' unconscious knowledge.

In support of their hypotheses, Gur and Sackeim found that at a verbal (conscious) level the success group committed false positive errors and the failure group committed false negative errors, but subjects' physiological responses were appropriate to the stimulus (weak for another's voice even though incorrectly identified as their own, and strong for their own voices, even when incorrectly identified as the voice of another). Note how Gur and Sackeim attempted to fulfill the conditions of self-deception—that individuals harbor two contradictory beliefs simultaneously ("this is my voice"/"this is not my voice"), one consciously (verbal report), one unconsciously (physiological response). (The assumption that the true belief was not subject to awareness was assessed by a post-experiment questionnaire). Finally, the motive for self-deception was manipulated through experiences of success and failure.

Although the Gur and Sackeim study is certainly the most ambitious attempt to demonstrate self-deception, its results are open to alternative interpretations. The success/failure manipulation may not have caused the subjects to be self-deceptive; rather, it may only have caused them to attend differently to the voices. Instead of responding to the question "is this voice yours or the voice of another?" the subjects may have asked themselves "is this my voice?"—a question that evokes a yes/no response. If this were the case, identifying a voice as one's own would entail a positive response. Success subjects may have felt elated by their score on the "intelligence" test, which may have evoked an orienting response. According to Lacey and Lacey (1973), orienting responses heighten sensitivity to novel stimulation, direct attention, and facilitate information intake. Thus, successful subjects may have attended more to the task and felt more inclined to provide positive (i.e., "yes, this is my voice") responses. The tendency for failure subjects to give negative responses may have been caused by the negative affect they were experiencing. As a result of their failure at the IQ task, subjects may have withdrawn from the task and therefore have been less inclined to make positive responses.

Recently, Gur and Sackeim's research has been challenged by Douglas and Gibbins (1983). Following a replication and extension of one of Gur and Sackeim's voice recognition experiments, Douglas and Gibbins question whether the false positive and false negative errors that sub-

jects made were motivated, and therefore self-deceptive. The basis for their challenge lies in the finding that subjects required to identify the voices of acquaintances behaved in the same way as subjects required to identify their own voices. Sackeim and Gur (1985) defended their interpretation of the outcome as evidence of self-deception, but not to the satisfaction of Gibbins and Douglas (1985). Note that Douglas and Gibbins (1983) do not dispute the evidence—they replicated the findings of Gur and Sackeim's earlier work—but they differ in their interpretation of the results. Douglas and Gibbins argue that because subjects in self-deception conditions react in the same way to voices of acquaintances as they do to their own voices, their behavior is not self-deceptive. Sackeim and Gur counter that these results show that people deceive themselves about acquaintances in much the same way they deceive themselves about themselves. Sociobiologists would be quick to see the generalization to acquaintances in terms of the "extended-self" application of inclusive fitness (see Krebs, 1987).

PERCEPTUAL DEFENSE AND SUBLIMINAL PERCEPTION

In his 1985 book, Trivers lists several "mechanisms of self-deception." Among them are perceptual defense and perceptual vigilance. As with self-deception in general, perceptual defense is paradoxical: how can people defend against information they don't perceive? Once again, the answer demands a divided consciousness—one (unconscious) part of the mind registering and keeping the aversive stimulus from another (conscious) part of the mind. Of course, this condition is difficult to establish and to distinguish from avoidance and denial—not attending to something that might be aversive or perceiving an unpleasant stimulus long enough to decide one doesn't want to think or talk about it.

Research on subliminal perception, or perception of below-threshold stimuli, suggests that information of which we are not aware may affect our judgments. For example, transient odors may dramatically alter our mood (Kirk-Smith, Van Toller, & Dodd, 1983). Recent research (Cheesman & Merikle, 1985; Jaynes, 1986) supports the idea that individuals "may respond to events they have perceived but not noticed" (Bowers, 1987, p. 98). Consider a typical study on subliminal perception. Marcel (1983) flashed words such as *lady* so quickly that subjects reported they could not see them, but Marcel found, nonetheless, that the subjects were able to select, at a level that exceeded chance, the word that was most similar from a pair such as *girl/book*. Of course, it is difficult to establish that subjects are telling the truth about their perceptions; and they may have seen enough of the word to know it falls in one domain but not another even though they did not form a clear image of it. The human ability to narrow the domain of possible correct answers

is evident in our ability to solve brain teasers such as: The same nine letters, if rearranged, will form two different words that can fill in the blanks of the following sentence correctly: "The musician's mother said that her sons and her brother both played many instruments: My— —are indeed very— —."

Brain researchers also have reported evidence of unconscious perception. For example, some individuals with lesions in their visual cortex who are "consciously" blind respond to visual stimuli. These patients insist they cannot see anything, and attribute their ability to point correctly to visual stimuli to guessing (Weiskrantz, Warrington, Sanders, & Marshall, 1974). This phenomenon may be akin to hysterical blindness and other conversion disorders, with physical rather than psychological blocking mechanisms.

CONVERSION AND DISSOCIATIVE DISORDERS

The sudden appearance of physical dysfunctions such as deafness, blindness, and paralysis of a limb without physical cause characterizes conversion hysteria. Robert Malmo (1970) describes the case of a young woman who suddenly became deaf. An examination revealed no physical impairment, and faking was ruled out because she was not startled by a loud clap behind her back. However, electronic sensors attached to her body revealed that she "heard" the clap at an unconscious level, because she made appropriate psychophysiological responses to it. Malmo set up a classical conditioning situation in which a loud noise was paired with an electric shock, and exposed the woman to repeated pairing of the sound and shock. Eventually, the sound alone evoked psychophysiological responses associated with the anticipation of shocks, demonstrating the woman could indeed hear the sound unconsciously.

Multiple personality is a rare and extreme form of dissociation in which two or more separate "personalities" (or sets of organized beliefs and behaviors) are apparent in one individual. Often the personalities represent extremes—one good, the other bad, appearing and disappearing, one at a time, none cognizant of the others. It is possible that the central difference between multiple personality and normal personality lies only in the ability of the alternate personalities in the dissociative disorder to emerge in consciousness. Consider, for example, the following observations on split-brain patient Paul S. Paul S. was unusual because his right hemisphere possessed rudimentary language skills, and, therefore, could communicate by manipulating alphabet blocks. LeDoux et al. (1979) found that Paul S.'s left and right hemispheres harbored quite different aspirations: His left hemisphere aspired to be a draftsman, whereas his right hemisphere aspired to be an auto racer.

HYPNOSIS

Ernest Hilgard's (1986) experiments with hypnosis provide further evidence for divided consciousness. Hilgard uses the metaphor of a "hidden observer" to "describe a memory structure based on material that the person had registered and stored in memory without being aware that the material had been experienced and processed" (p. 293). The "hidden observer" is demonstrated in a technique in which a hypnotized subject is given the suggestion that he or she will feel no pain when his or her arm is placed in ice water. Subjects overtly report experiencing little or no pain, but covertly report near normal levels of pain.

Hilgard's research on hypnosis suggests a vertical split in consciousness with the "hidden observer in all respects like the normal observing part found in waking. It is objective and well oriented to reality" (Hilgard, 1986, p. 233). This research suggests parallel information processing, that is, two ongoing experiences that are dissociated from each other, or separated by an "amnesic barrier" that allows a set of information to be registered and processed but not represented in awareness (Hilgard, 1986).

In summary, research from a diverse array of areas, from neurological studies of split-brain patients to studies of psychological disorders and hypnosis suggests that humans possess a divided mind, with different parts processing information in different ways. As described by LeDoux et al. (1979), MacLean (1973), and others, the evolution of the human brain involved the acquisition of increasingly complex levels of control, with more sophisticated levels growing on top of, not replacing, the more primitive (old brain, limbic system) structures (in much the same way the brain develops ontogenetically). Although, with development, the linearly logical, conscious, verbal (left hemisphere) processes attain increasing "executive" control, other, more primitive (old brain), and unconscious processes still determine human behavior.

The products of a layered and modular human brain are different forms of knowing (Bowers, 1987; Gardner, 1983; Gazzaniga, 1985; Symons, 1987). Sensory images are one form of knowledge. Our ability to drive a car, to carry a tune, to react to expressions of emotion in other people, and to learn through conditioning are others. Our multiple ways of knowing operate simultaneously, generating multiple forms of knowledge, even though most of them are unconscious. Among these many forms, perhaps as a master controller is an "interpreter" (Gazzaniga, 1985) or "second-order consciousness" (Bowers, 1987) whose function is to *interpret* the items of experience, including ideas, feelings, and behaviors that stem from unconscious sources. The (left hemisphere) interpreter develops hypotheses, theories, and beliefs about ourselves and our worlds; it accounts for the order of things, including our nature and the determinants of our behavior.

The existence of different information-processing mechanisms in the brain, some conscious, most unconscious, paves the way for self-deception. Research has offered convincing evidence that individuals may harbor contradictory beliefs simultaneously in conscious and unconscious parts of their minds. And, as will become clear, it often is in individuals' interest to deceive themselves. However, no one as yet has established that an unconscious part of the mind *intends* to deceive a conscious part.

Biases in Self-Conception

In addition to perceptual defense, which we have considered, Trivers (1985) mentions four other "mechanisms of self-deception": *benefectance*—"the tendency to represent ourselves as being beneficial and effective at the same time" (p. 418); *exaggeration*—the tendency to amplify and exaggerate beneficial outcomes through repeated accounts of an event; *illusion of consistency*—"the tendency for people to rewrite their past experience so as to make it consistent with present realities" (p. 419); and *perception of relationships*—the tendency for both members of a relationship to believe they are doing more than their share.

In labeling these phenomena "mechanisms of self-deception," Trivers (1985) implies that they stem from a divided mind, one part intending to deceive the other, and that they evolved to serve deception, but Trivers's treatment of these mechanisms is purely descriptive; he does not offer any evidence to support the assumption that they involve self-deception. Psychologists who have investigated the cognitive biases and distortions described by Trivers rarely attribute them to self-deception. We will supply a brief overview of psychological research on the cognitive biases described by Trivers (and additional biases), then examine the implications of these biases for an evolutionary analysis of self-understanding.

Anthony Greenwald (1980) coined the term *benefectance* "as an umbrella term to cover phenomena previously labeled as self-serving, egocentric, egotistic, and ego-defensive attributions by other writers" (Greenwald & Pratkanis, 1984, p. 139). He defined it as "the tendency for self to be perceived as effective in achieving desired ends while avoiding undesired ones" (Greenwald & Pratkanis, 1984, p. 139). *Self-serving attributional biases* refer to the tendency for people to take credit for their successes by attributing them to internal dispositions such as skill or intelligence, and to deny responsibility for their failures by attributing them to external circumstances such as social pressure or bad luck. A spate of studies have found that individuals tend to view their successes and failures in a self-serving way, but to attribute the successes

of others (at least those with whom they are not identified) to external factors and the failures of others to internal dispositions. For example, when Miller (1976) gave subjects a bogus social-perceptiveness scale and manipulated their scores, he found that subjects who received high scores attributed their success to their social sensitivity and effort, whereas subjects who received low scores attributed their failure to task difficulty and bad luck.

Nisbett and Ross (1980) review the vast literature on self-serving biases (see also Ross & Fletcher, 1985). While many studies have reported them, some have not: "Laboratory evidence (and much anecdotal evidence as well) leaves little doubt that in some situations actors hold themselves more responsible for failures than for successes" (Nisbett & Ross, 1980, p. 232). Individuals do not employ the beneffectance bias unconditionally. In order to understand why, another bias must be introduced.

Attributing failure and other types of misfortune to bad luck or to external adversity has a potential drawback—the implication that one is not in control of one's outcomes. People need to feel in control; this has been demonstrated repeatedly in research on social cognition. Indeed, people commonly assume they can influence events beyond their control—a phenomenon labeled by Langer (1975) as the *illusion of control*. For example, people shooting crap commonly believe that blowing on the dice will increase the probability of them rolling a desired number, or throwing them hard will cause the numbers to be high (Langer & Roth, 1975). And people commonly believe they are more likely to win a lottery if they select their own numbers than if they are assigned a number (Langer, 1975).

When people make attributions about positive outcomes, the self-serving bias and the illusion of control support one another: "I did it, and I'm proud." However, when people are faced with failure, each bias counteracts the other ("I don't want to be a failure, but I don't want to be a victim of circumstance either"). While some studies have demonstrated that the two biases are interchangeable (Alloy & Abramson, 1982), others have found that, depending on the circumstances, one or the other prevails (Weiner et al., 1972). According to Fiske and Taylor (1984), the preference for one bias over the other depends on the kinds of attributions available to people. People tend to take responsibility for failure when they can attribute it to an internal factor over which they have control, especially one such as effort that reflects only a temporary state (see also Weiner et al., 1972); however, when such attributions are unavailable (because, for example, an individual tries hard), people tend to make external attributions ("the test was unfair").

Closely associated with the illusion of control and self-serving biases (and also an aspect of beneffectance) is the *self-centered bias*. People tend to accept more responsibility for outcomes involving joint effort than is

warranted by an objective assessment of the situation. For example, Ross and Sicoly (1979) found that subjects took more responsibility for the success of a social occasion (a group product) than others thought they deserved. Interestingly, this bias occurs in assessments of unsuccessful as well as successful outcomes (which is what distinguishes it from self-serving biases). For example, Thompson and Kelley (1981) gave a list of 21 activities to individuals who were involved in relationships (either married or living with someone) and found that they believed they contributed more to both positive activities (e.g., resolving arguments) and negative activities (e.g., causing arguments and embarrassing your partner in public).

Affiliated with but distinguishable from self-serving and self-centered biases is the tendency for people to structure their memories around the roles they played in and their contributions to social occasions (Greenwald & Pratkanis, 1984). The *egocentricity bias* is apparent when, in recounting a social incident, the participants represent themselves in the best possible light by, for example, remembering their own arguments, enhancing them, and diminishing their opponent's arguments. Greenwald and Pratkanis (1984, p. 139) further recognize a "tendency to insert self into perceived causal sequences, either as influencing agents [the illusion of control] or as influenced object" (Fenigstein, 1983; Jervis, 1976; Zuckerman, Kenis, Guarnera, Murphy, & Rappoport, 1983).

In addition to attributional biases relating to success and failure, control, and contributions to joint efforts and social occasions, researchers have observed biases relating to people's sense of (a) the representativeness of their ideas—the extent to which their ideas are shared by others—and (b) the extent to which they are unique. The *false consensus effect* refers to the tendency for individuals "to see their own behavioral choices and judgments as relatively common and appropriate to existing circumstances, while viewing alternative responses as uncommon, deviant, and inappropriate" (L. Ross, Greene, & House, 1977, p. 280). For example, people tend to overestimate the popularity of their political and racial attitudes (Fields & Schuman, 1976; Korte, 1972); and individuals experiencing conflict in relationships incorrectly predict the degree to which their partner agrees with their perception of the cause of the conflict (Harvey, Wells, & Alvarez, 1978). A recent meta-analysis concluded that "the combined effects of the [115] tests of the false consensus hypothesis were highly statistically significant and of moderate magnitude" (Mullen et al., 1985, p. 262).

But people do not always view themselves as common (Kernis, 1984, p. 351). The *assumption of uniqueness* is a bias in self-conception that involves viewing oneself as unique, despite objective evidence to the contrary, and overestimating the degree to which others perceive you as unique (M. Ross, 1981). This bias is commonly reflected in people's perceptions of their personality traits (Fromkin, 1972), their importance in

a group—being a key actor—and predictions of future success (M. Ross & Sicoly, 1979). For example, researchers have found that the average person overestimates the probability (relative to peers) that he or she will own a house, have a good job, and live past the age of 80 (Weinstein, 1980), and underestimates the probability of getting divorced (Perloff, 1983; Perloff & Fetzner, 1986), contracting a disease (Kirscht, Haefner, Kegeles, & Rosenstock, 1966), and suffering a heart attack (Larwood, 1978). Note that this sense that one is special may discourage people from taking adequate precautions to avoid negative events such as a heart attack (Larwood, 1978; Perloff, 1983; Weinstein, 1983).

People's ability to recall self-relevant information better than information about others is well documented: people "consistently seek and recall information that confirms their self-concepts (Swann & Read, 1981a, 1981b). For most people, the bias is in a self-enhancing direction (Greenwald, 1980); that is, people especially seek information related to the positive aspects of their self-concepts" (Fiske & Taylor, 1984, p. 156). Trivers (1985) mentions the *illusion of consistency*, noting that people are remarkably good at rewriting early opinions to give the impression they are consistent with new ones (Bem & McConnell, 1970; Goethals & Reckman, 1973; L. Ross & Shulman, 1973; M. Ross, McFarland, & Fletcher, 1981). Similarly, people remember past behavior as more consistent with their present behavior than it actually was (M. Ross et al., 1981, 1983).

Finally, the *hindsight bias* refers to the observation that outcomes appear inevitable in retrospect (Fischhoff, 1982). This bias leads people to believe they would have known what would happen, that they *did* know in foresight, and that others should know in foresight (cf. Sherman & Corty, 1984). Perceiving a "past without surprises" engenders a (false) sense of security and impedes our ability to learn from what has happened. In a recent study, subjects judged a criminal assault on an individual to be less surprising in hindsight than in foresight, despite the fact that descriptions of the event were identical in the two circumstances (Higgins, 1987).

Proximate Determinants of Biases in Self-Conception

That the process of perceiving oneself is burdened by biases is indisputable. Thousands of studies have supplied supporting evidence. But why? What causes these biases? Trivers (1985) views them as mechanisms of self-deception, but, as indicated earlier, it is unclear whether they meet the criteria of self-deception, defined strictly. Psychologists who study cognitive biases tend to prefer one of two types of explanation for their origin—explanations labeled "hot" and "cold" in the literature. "Hot" theories attribute biases to self-serving motives such as the need to

enhance and protect one's self-esteem and to impress others. "Cold" theories attribute them to the natural process of human inference.

Consider self-serving biases, for example. Perhaps the most obvious reason why people take credit for their successes and blame other factors for their failures is to enhance their self-esteem and protect their egos. Alternatively, these biases may serve impression management; or they may stem from the need to feel in control—to maintain a sense of mastery over one's fate. All of these "hot" explanations have been offered by researchers (see M. Ross & Fletcher, 1985), but the postulation of cognitively biasing needs for self-enhancement and control may not be necessary.

Miller and Ross (1975) provide an alternative, "cooler" explanation for self-serving biases: people *intend* their behavior to produce success, so they *expect* a positive outcome. When this expectation is met, they accept responsibility for it. When it is not—when they fail—the outcome is seen to have occurred despite their efforts, so they do not take responsibility for it (Miller & Ross, 1975; L. Ross, 1977).

The connection between effort and the expectation of an intended result also may explain the illusion of control. People may be primed cognitively to expect effort (throwing dice hard) to produce success (a high number). Therefore, the illusion of control may stem from a failure to differentiate outcomes that can be altered through effort from those that cannot (i.e., it may stem from overgeneralization); or, in a hotter vein, it may stem from people's need to feel powerful.

The same sort of ambiguity surrounds the source and purpose of the self-centered bias. On the one hand, overestimating your contributions may enhance your self-esteem, bolster your ego, and serve your self-interest (the greater your contributions, the greater your returns). On the other hand, people may overestimate their contributions to joint efforts because their contributions are more salient to them than the contributions of others. For example, individuals may overestimate the proportion of housework they do because they are more aware of the chores they do than of those done by their mates. Or maybe a "warm" synthesis supplies the best explanation: People may think of themselves as the kind of person who does a particular activity, and therefore attribute greater responsibility to themselves for the task (Thompson & Kelley, 1981).

Similarly, recalling past events inaccurately and reporting that new attitudes and behaviors are consistent with old ones may reflect ego-enhancing or defensive mechanisms or impression management strategies, on the one hand; or they may simply reflect the tendency for people to remember information that is most salient (egocentricity) or relevant (illusion of consistency).

As for the false consensus effect, on the one hand consensual validation may help people justify beliefs that might otherwise seem arbi-

trary, i.e., supporting the sense they are “right” (Goethals & Darley, 1977; Kelley, 1967; L. Ross et al., 1977), and it might help people feel normal, appropriate, and rational (Goethals, 1986). On the other hand, in a cooler vein, it may stem from the tendency for people to associate with those who support their opinions—reflecting valid inferences based on unrepresentative samples of information; or it may stem from the cognitive ease with which people imagine similarities versus differences (L. Ross et al., 1977).

Both hot and cold explanations have also been offered for the assumption of uniqueness. On the one hand, the assumption of uniqueness could stem from the need to see oneself as special (Lefcourt, 1973); or, on the other hand, it might reflect people’s awareness of their own efforts, plans, achievements, and capabilities (M. Ross & Fletcher, 1985).

Finally, like the false consensus effect, the hindsight bias may support people’s sense that they are “right” (e.g., L. Ross et al., 1977), or stem from the need to feel in control. Or it may be a result of an inconsistent use of rules in predicting and explaining events (Fischhoff, 1982).

To summarize, sociobiologists have suggested that self-deception evolved to serve social deception in species burdened with the ability to detect their own lies. Evidence from several areas of research supports (but does not establish) the idea that because humans possess a divided consciousness, one (unconscious) aspect of themselves may deceive another (conscious) aspect. Psychologists have established unequivocally that the process of human inference, especially the process of self-conception, is biased, but there is disagreement among them about the source of the biases. Some psychologists attribute them to “hot” (ego-enhancing and defensive) sources; others attribute them to “cold” biases in information-processing; still others adopt “warm” compromise positions (e.g., Tetlock, 1984). Yet, in spite of their differences, psychological theorists focus on *proximate* causes—on the immediate cognitive and “motivational” determinants of social judgment.

We believe the sociobiological analysis of self-conception has been unnecessarily constrained by its focus on self-deception. In the remainder of this chapter we attempt to expand the scope of both the sociobiological and psychological approaches: we fashion, with broad strokes, a sketch of the evolution of knowledge, especially self-knowledge, explaining why, when viewed from the *ultimate* lens of natural selection, hot and cold, deceptive and nondeceptive, and valid and invalid forms of knowing should evolve in the human species.

The Adaptive Value of Valid Knowledge

Although social psychologists have focused on biases and distortions in social cognition, and although sociobiologists have focused on the adaptive value of self-deception, it is important not to neglect the human

ability to construct valid representations of experience and to tie them together logically in systems of thought. Many theories are based on a rational model of human behavior. For example, the personality theorist, George Kelly (1955) writes:

It is customary to say that the scientist's ultimate aim is to predict and control. This is a summary statement that psychologists frequently like to quote in characterizing their own aspirations. Yet curiously enough, psychologists rarely credit the human subjects in their experiments with having similar aspirations. It is as though the psychologist were saying to himself, "I, being a psychologist, and therefore a scientist, am performing this experiment in order to improve the prediction and control of certain human phenomena; but my subject, being merely a human organism, is obviously propelled by inexorable drives welling up within him, or else he is in gluttonous pursuit of sustenance and shelter (Kelly, 1955, p. 5).

Kelly goes on to argue that people attempt to predict and control their worlds by developing mental *constructs* that form more or less highly integrated systems. Constructs are revised and elaborated to correspond with the phenomena they represent. Among the most important constructs are constructs about the self.

In social psychology, attribution theorists such as Fritz Heider (1958) and Harold Kelley (1967) have developed rational theories of attribution, treating individuals as naive scientists observing the behavior of others and making logical deductions about their causes. According to later theorists, people make attributions about their own behavior in much the same way they make attributions about the behavior of others. For example, Bem's (1965) theory of self-perception is founded on the assumption that "individuals come to know their own attitudes, emotions, and other internal states by inferring them from observations of their own overt behavior and/or the circumstances in which this behavior occurs" (M. Ross & Fletcher, 1985, p. 98).

In developmental psychology Piaget outlined the growth of rational thought in children, viewing them as young scientists or philosophers developing increasingly adequate theories of the physical world. Others have extended the Piagetian model to social phenomena such as the development of perspective-taking skills (Selman, 1980) and the growth of moral reasoning (Kohlberg, 1984). Damon and Hart (1982) outline a rational reconstruction of the development of children's understanding of themselves (Figure 4.1). Theories such as these are based on the assumption that children seek to understand their worlds in increasingly adequate ways, that they develop increasingly differentiated, integrated, and equilibrated structures of knowing, which provide increasingly sophisticated and valid constructions of reality. These theories, like the other rational theories we have mentioned, have been supported by a spate of research.

The biologically adaptive value of the ability to represent experience symbolically is obvious. It enables individuals to anticipate events, to

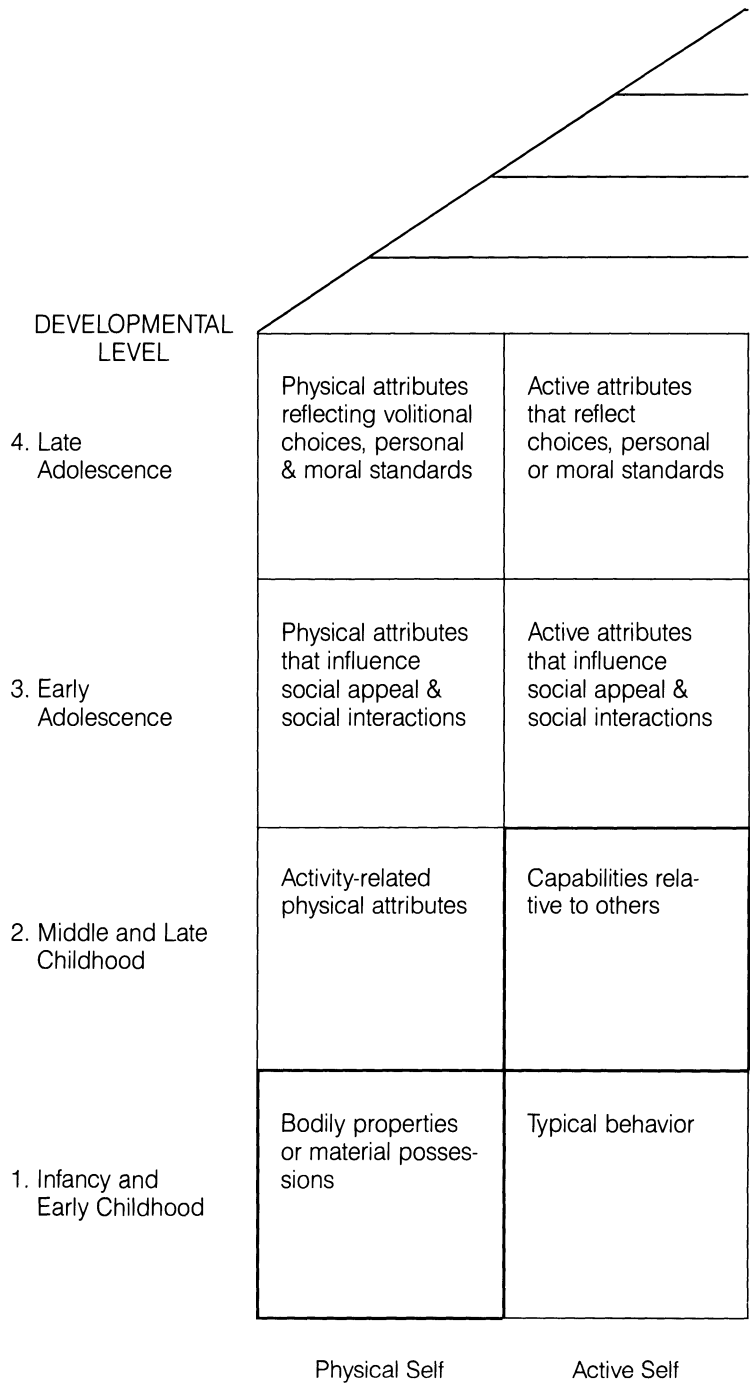


FIGURE 4.1. The Damon and Hart developmental model of understanding. [From Damon, W. & Hart, D. (1986b). Stability and change in children's self-understanding. *Social Cognition*, 4, p. 110.]

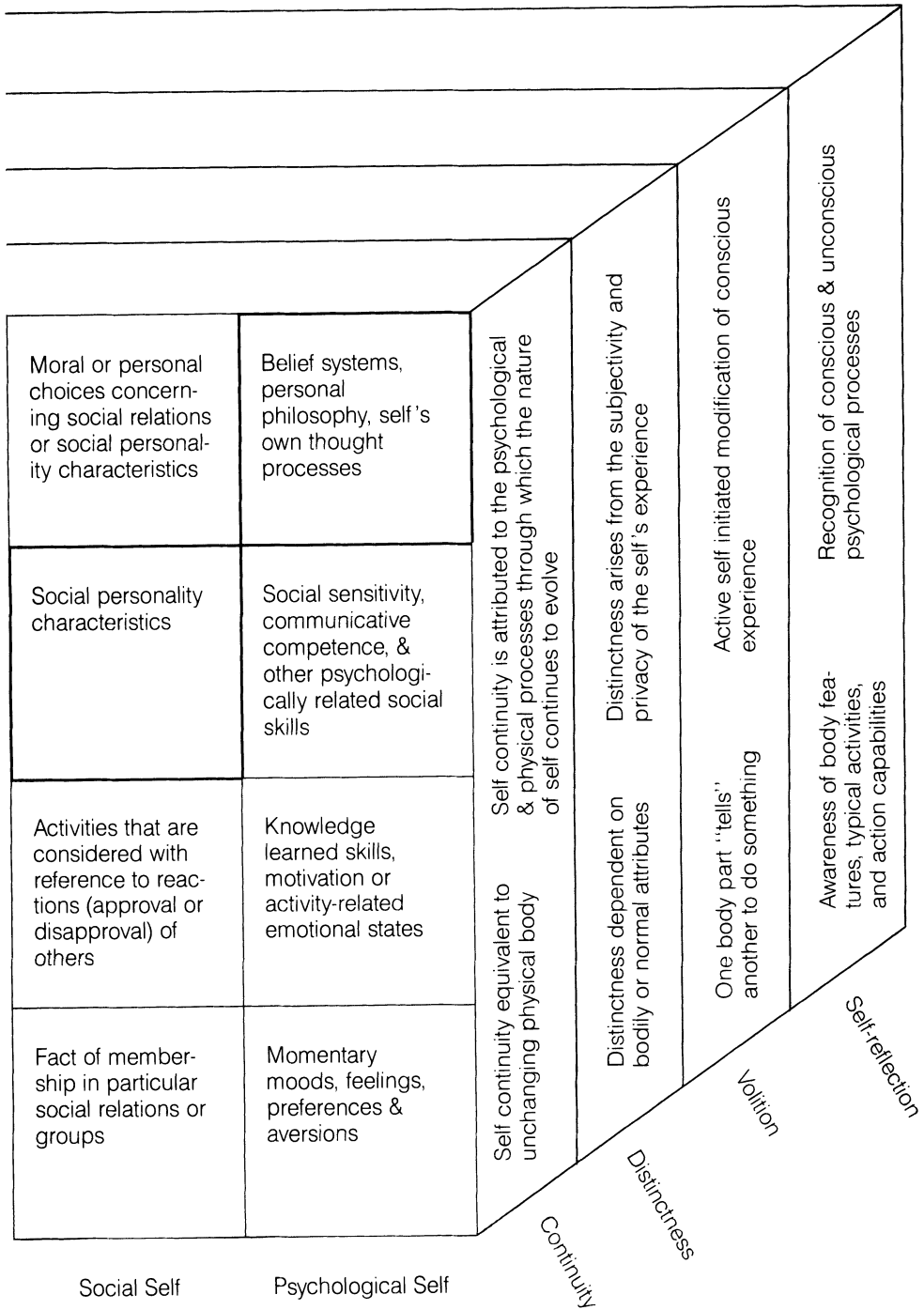


FIGURE 4.1. (Continued).

discover relationships without physically engaging in trial and error, and to manipulate ideas in their heads—in short, it enables them to predict, control, and understand. From an evolutionary perspective, individuals who acquired the ability to predict the behavior of game, friends, and foe could anticipate it, prepare for it, and, perhaps most important, manipulate it to their advantage. Individuals who developed invalid knowledge would misjudge events and suffer the maladaptive consequences. The ability to represent ideas symbolically enabled early humans to make tools and to develop highly adaptive modes of communication. The value of symbolic knowledge is amply apparent in our society, with its high level technology and investment in education.

There are, however, limitations on both the representativeness and adaptive value of high-order cognition. To begin with, as discussed earlier, the type of rational thought investigated by theorists such as Piaget is primarily a product of the left hemisphere. Because it monopolizes our consciousness, we assume it is everything. But nonhuman animals know—they learn and acquire knowledge, even though most of them seem unable to manipulate ideas symbolically. Humans undoubtedly possess other forms of knowing too.

Second, because many determinants of our behavior are unconscious and inaccessible, and because the world is infinitely complex, we can know only an infinitesimal part of what there is to know. This complexity opens the gate for a tremendously large, if not infinite, variety of plausible hypotheses, and it paves the way for the development and justification of a wide array of beliefs. In Hofstadter's (1985) words, we don't "have to be one way" (p. 629). The looseness of our conceptual boundaries permits all kinds of innovative combinations.

The Adaptive Value of Pragmatic Conclusions

In the face of infinite complexity, a purely "rational" course of action would be to suspend belief, to hold conclusions in abeyance until there is adequate evidence. But this would be highly maladaptive in many circumstances. Adages such as "he who hesitates is lost" and "the early bird gets the worm" imply it is adaptive to act on best guesses. Early humans who waited until they fully understood the behavior of potential mates before making their move would have been no more fit than the modern individual who sits at home alone, looking at the telephone. In evolutionary currency, the adaptive value of knowledge lies primarily in the behaviors to which it gives rise. Individuals who don't try don't succeed. Individuals who take a quick reading of a situation, reach a working conclusion, then act will fare better in many circumstances than those who engage in extended rational analyses.

Recent advances in the study of human inference have shown that we rarely use formal rules of inference in everyday life: "the kinds of princi-

ples devised by logicians . . . and invoked by researchers like Piaget . . . have only limited applicability to how we reason in the real world" (Gardner, 1986, p. 370). Tversky and Kahneman (1980) and others have shown that people use heuristics when making judgments in their everyday lives: heuristics driven, for example, by the availability and salience of information. Indeed, heuristics are used by professional statisticians and mathematicians when they are not at work (Tversky & Kahneman, 1971). According to Kahneman (1986), the three principles typically emphasized in models of rationality (invariance, consistency, internal coherence) are *not* a guiding part of our mental system, and rational models have hindered rather than helped our understanding of human behavior.

In the social domain, theorists such as Harold Kelley (1972) have come to the understanding that people often do not weigh evidence in a rational manner when making attributions about the causes of others' behavior; rather they employ "causal schemata" – simplified ideas about the connection between events and their causes. People process a limited sample of information, and, if it meets the criteria of causal schemata, jump to an appropriate conclusion. Markus (1977) and others suggest individuals develop "self-schemata" that guide the processing of information about the self. Self-schemata supply selective filters that channel the information that people process, organize the storage of information, and direct the retrieval of memories. In filtering information, self-schemata cause individuals to "actively construct reality . . . create meaning and add on to it the raw data of the objective world" (Fiske & Taylor, 1984, p. 141).

The "cold" biases in self-conception considered earlier can be viewed as products of both limited information and pragmatic shortcuts for understanding oneself and others. Such working strategies for making educated guesses are adaptive because, on balance, they produce functional conclusions. We suspect that if the "hits" and "misses" (reckoned in terms of inclusive fitness) of heuristics and other pragmatic shortcuts were compared, the hits would far outweigh the misses. For example, greater effort (such as that involved in throwing dice hard) usually produces better results. Little is gained in exempting dice-throwing from the rule, especially if it fosters confidence. Formal logic and the scientific method are privileged forms of cognition, adaptive only in (often academic) circumstances where evidence is available and one has time to weigh it.

The same point applies with poignancy to moral reasoning. Murphy and Gilligan (1980) suggest that adolescents go through a stage in which they experiment with the types of abstract moral reasoning that define Kohlberg's highest stages of moral development, discover that it can be used to reach any number of valid conclusions, and abandon it in favor of more relativistic and contextual (i.e., pragmatic) reasoning. Norma Haan (1983) challenges the representativeness of the rational

structures of moral reasoning described by Kohlberg, arguing that individuals employ significantly more practical (and interpersonal) strategies in everyday life:

Structures [of moral reasoning] represent stable, organized principles of deciding and knowing, while personality . . . is composed of strategies that deal with the vagaries and the contingencies of living and inevitably include not only affects but also contents. True enough, man is preeminently a thinking being, but this thought cannot be singularly reified (or deified) since he is also a feeling being who is sometimes even foolish. Not all his concerns and acts can be captured in an account of his pristine, linear logic in its varying states of evolution (p. 101).

Studies described in recent papers by Krebs, Schroeder, and Denton (1987) and Denton, Schroeder, and Krebs (1987) supply evidence that the structures of “pure” Kohlbergian reasoning assessed by Kohlberg’s test are not representative of real-life moral reasoning involving the self and significant others; real-life reasoning is significantly more pragmatic, self-interested, and adaptive. In Chapter 5 of this volume, Kevin McDonald reviews evidence on the representativeness of rational moral judgment and reaches a similar conclusion. Do philosophers of ethics employ the principles they study when they interact with others in everyday life?

The Adaptive Value of False Beliefs

It is a short step from the recognition that best guesses sometimes are more adaptive than rational decisions to the conclusion that false beliefs sometimes are more adaptive than no beliefs, and from there to the conclusion that false beliefs may be more adaptive than valid beliefs. Humans possess a pressing need to believe. The feeling of not knowing is tensely unpleasant; the feeling of knowing is relaxed and pleasurable. Consider, for example, the frustration of having a word on the “tip of your tongue” and the relief of retrieving it (Brown & McNeill, 1966), or the tension evoked by unsolved problems. (The answer to the problem presented earlier is *relatives* and *versatile*.)

It is not the validity of beliefs that counts in natural selection, it is the adaptiveness of the behaviors to which they give rise. Structures that produce beliefs that give rise to behaviors that enhance individuals’ fitness should be selected, regardless of the validity of the beliefs. In general, it is adaptive to distort reality when the truth hurts—when acknowledging the truth makes one less fit than believing a lie. From an evolutionary perspective, knowing the truth (valid ideas, logical inferences, accurate memories) may be *maladaptive*. *Invalid* beliefs, *misconceptions*, and *self-delusions* may be more fitness-enhancing, especially as pertains to conceptions of self.

The “hot” explanations for biases in self-conception considered earlier form a system of interrelated proximate processes that are ultimately fitness-enhancing. Individuals who have high self-esteem, who believe in themselves, and who think they are special tend to be more fit than those who do not. Feeling secure, optimistic, and in control of one’s life is an adaptive state; insecurity, pessimism, and a sense of futility are maladaptive. Although the channels through which self-esteem, optimism, and self-efficacy exert their adaptive effects are undoubtedly complex, the following four interrelated sequences supply representative prototypes. First, distorting reality makes people feel good; feeling good is physically healthy; and physically healthy people are more likely to survive, be attractive to others, and reproduce than unhealthy individuals. Second, beliefs that endow life with lofty purposes and foster a false sense of security keep people going; perseverance is adaptive because individuals who keep on trying are more likely to succeed than those who give up. Third, beliefs that foster a sense of control and self-confidence are adaptive both because they foster perseverance and because they (and therefore those who harbor them) are socially attractive. Finally, in general, beliefs that are false in their inception, when acted on with conviction, may set up self-fulfilling prophesies, thereby validating them. Let us consider some implications of each of these points.

VITAL LIES

We all have been interrupted while in reverie and attempted to recapture the warm feelings radiating from our lost thoughts. As demonstrated by daydreams and fantasies, certain ideas induce positive affective states. Happy people tend to be healthier than unhappy people. Indeed, it is difficult to distinguish between the physical and psychological symptoms of anxiety and depression. Health induces happiness, and happiness induces health. And happiness has a social premium—people are avoided when they are angry or morose.

Are the beliefs of happy and healthy people false? In a recent book, *Vital Lies, Simple Truths* (1986) Daniel Goleman reviews a spate of evidence supporting the connection between false beliefs, positive mental states, and physical health. In a recent study, McFarland and Ross (1982) demonstrated that “internal attributions for success produce more positive affect than do external attributions, and that external attributions for failure produce less negative affect than do internal attributions” (cf. Pyszczynski, Greenberg, & LaPrelle, 1985, p. 197). Conversely, facing the truth may make people unhappy (and unhappy people may be more prone than happy people to face the truth about themselves). Several studies have found that depressed people make more unfavorable *but more valid* attributions than those who are not

depressed (see Alloy & Abramson, in press). Recent research also suggests that teaching individuals to make self-serving ("optimistic") attributions allays depression. Other studies have found that a good dose of denial is excellent elixir (see Peterson & Seligman, 1984). Goleman (1987) reports that patients who denied the risks of impending surgery ("with a Pollyannaish optimism") "had fewer medical complications [after the surgery] and were discharged sooner than were the more vigilant patients" (p. 26). And Trotter (1987) reports that five years after mastectomy, "75 percent of the women who had reacted to the disease with a fighting spirit or who denied they had cancer were still alive and had no recurrence of the cancer. Only 35 percent of the women who stoically or helplessly accepted the disease were still alive with no recurrence" (p. 37).

FALSE SECURITY

Earlier we identified the ability to predict events as one of the essential functions of knowledge. Here we point out that the *sense* that events are predictable, whether valid or invalid, is adaptive in itself. A sense of predictability gives rise to a sense of security that rests either on the assumption that the world is an orderly place in which people will be taken care of and get what they deserve (benign external control), or that people possess the ability to determine their own fates (illusion of control).

Two of the primary functions of religious beliefs are to foster in individuals the adaptive delusion that superior powers are looking after them and to offer explanations for the inexplicable: God is omnipotent and omniscient; "He" looks after us and "He" works in mysterious ways. Evolutionary theory implies there really isn't any purpose to life; the environment simply selects adaptive characteristics. If one must endow life with purpose, it is to propagate genes: the purpose of chickens is to produce eggs, and the purpose of eggs is to produce chickens. All organisms, including humans, are tiny cogs in the cosmic wheel—as dispensable as an ant or a fly. Once we propagate our genes and do our bit to insure they survive to produce replicas of themselves, we have fulfilled our purpose. According to sociobiologists such as Dawkins (1976), individuals are "survival machines" programmed by genes to make more genes.

People's resistance to the insignificance assigned them in evolutionary theory is explicable by evolutionary theory. What is more adaptive—to believe life is meaningless and one is insignificant, or to believe one is the star actor in an important play? A study by Kobasa (1979) supplies a representative answer to this rhetorical question. Kobasa found that healthy people have a greater sense of control over events in their lives, are more committed to their beliefs, and are more cognitively flexible

(susceptible to self-deception?) than people who become ill. “Staying healthy under stress is critically dependent on a strong sense of commitment to self” (Kobasa, 1979, p. 4). “Hardy” people tend to be committed to others (involve them in their lives), and to themselves (recognize their own capacities and importance as a person), and they tend to possess a belief system that includes a sense of the meaningfulness of life and personal control.

Existential philosophers such as Sarte, Camus, and Becker discuss the dilemma of humans faced with evidence of the meaninglessness of their lives. Faced with an awareness of the absurdity of life—the contradiction between desires and possibilities and the feeling that nothing an individual can do will make any lasting difference—people despair. Feelings of futility and the desire to take control may cause individuals to commit suicide.

The sense that life has a proper purpose, that benign deities are protecting us, and that we are masters of our own fate gives rise to feelings of *hope* and *optimism*. As documented by Tiger (1979), optimism is tremendously adaptive. In support of Tiger’s contention, Seligman (1987) reported that the immune system of “optimists” is significantly stronger than that of “pessimists.” For example, optimists report visiting doctors less and having fewer colds in a year (approximately half the number) than do pessimists (Seligman, 1987).

THE ILLUSION OF CONTROL

The unadulterated belief that individuals will be cared for would be maladaptive if it rendered individuals passive and irresponsible. Therefore, all religions attach a rider: “The Lord helps those who help themselves.” Earlier we adduced evidence for the illusion of control. Here we discuss its adaptive value.

Superstitions reflect the strength of people’s need to feel in control of inherently uncontrollable forces. Superstitions (including those sanctioned by formal religions) are false beliefs about the connection between behaviors and consequences. Our ancestors assumed that if they danced a certain way, supplicated certain gods, or avoided certain phenomena, they could control natural events (Hocart, 1952). Some of their rituals and sacrifices worked some of the time, usually for the wrong reasons. Partial reinforcement is powerful, and more than enough to reinforce false beliefs.

Are contemporary humans superstitious? You need only watch the rituals of professional baseball players to witness a clear answer to this question. Outfielders seem to be more superstitious than catchers, probably because catchers have more actual control over the direction of the ball. People perform rituals, wear “lucky” articles of clothing, and appeal to God to cultivate a sense of control. The illusion of control is

biologically adaptive because it fosters a (false) sense of security, *motivates* individuals to take responsibility, and induces them to persevere. The belief that one can control the outcomes in one's life serves as an incentive; it pulls people toward the behaviors entailed by the beliefs. It keeps them in the game. Within an optimal level, people who try succeed more than those who give up easily.

The physically adaptive value of the illusion of control is well demonstrated in the study by Kobasa (1979) discussed earlier. In another creative study, Langer and Rodin (1976) gave nursing home patients plants to keep in their rooms. Half the patients were asked to care for the plants, trim and water them, and half were told the nursing home staff would care for the plants. A year later the patients who were given responsibility for the plants were psychologically and physically healthier than the patients who were not given the responsibility (Rodin & Langer, 1977). Note that the plants would have been cared for in any event; according to Rodin and Langer, it was the sense of purpose and control experienced by the patients that had the salutary effect.

The sense that one is not in control of one's life induces anxiety. One way to reduce anxiety is to cultivate false beliefs. Spiegel (1987) reports a successful program for the treatment of fear of flying in which phobic individuals are taught to hypnotise themselves into viewing "the plane as an extension of their bodies rather than seeing themselves as victims trapped inside a machine" (p. 40)—that is to say to delude themselves about their ability to control. The treatment of anxiety often involves training patients to imagine they are not in the situation they are actually in when an anxiety attack begins to occur.

RESPONSIBILITY

There is, however, a catch to the illusion of control. With control comes responsibility. If one can affect the outcome of events, then one may be *held* responsible for them. Thus, there is a tension between the belief in free will and the belief in fatalism. If we have free will—if we can exercise choice and control over events—then we can be held responsible for what happens. If, on the other hand, outcomes are determined by events beyond our control, we might as well not try. The tension between these beliefs is evident in our culture, where, though personal responsibility is enshrined in religion and morality, we are prone to excuse reprehensible behavior—attributing it to factors such as stress, intoxication, insanity, or childhood adversity. Though repelled by the thought of being mere playthings of forces over which we have no control, we are reluctant to hold ourselves responsible for behaviors we abhor.

What happens when the need to believe one is in control of the outcomes in one's life comes into conflict with the need to evade responsibility? Belief in control appears to prevail. Not only may people blame

others for misfortunes for which they clearly are not responsible (Lerner, 1980), they also may blame themselves for their own misfortunes (Janoff-Bulman, 1979). People distort reality to blame others or themselves for accidents and to deny evidence that innocent people suffer (Lerner, 1980). For example, women who have been raped may blame themselves even though they were chosen at random by a rapist (cf. Fiske & Taylor, 1984). While on the face of it, taking blame for accidents seems a heavy burden, accepting responsibility may be an effective coping strategy—people who blame themselves tend to get “back on their feet” more quickly than people who blame external factors (Bulman & Wortman, 1977). The effectiveness of this coping strategy can be explained by the way people interpret their accidents. People attribute purposes to their own misfortunes and to the misfortunes of others (“It was God’s will”) (Bulman & Wortman, 1977), and blame actions (“I behaved irresponsibly”) rather than dispositions (“I am irresponsible”). As a result, they ease the burden—behavior can be changed, preventing future misfortunes (Janoff-Bulman, 1979). For example, attributing a rape to a decision that can be changed—the decision to walk home alone, for example—is less threatening than attributing it to forces beyond one’s control, such as malicious individuals who may strike without warning.

SELF-FULFILLING PROPHECIES

In addition to their salutary effect on people’s sense of security, confidence, and motivation, false beliefs foster fitness in another way: they tend to validate themselves. If you believe something strongly enough you can make it come true. Snyder (1984) adduces evidence from a wide array of studies to support the idea that “beliefs create reality.” Consider one of many examples. A study by King (1971) revealed that a welding instructor who was falsely informed that some of his trainees had a high aptitude for welding “influenced the trainees to perform in line with his expectations” (Snyder, 1984, p. 256). The “high aptitude” trainees (who were really chosen at random and who were completely unaware of the experimental manipulation) were preferred as co-workers by other trainees, “were absent less often than other workers . . . learned the basics of the welder’s trade in about half the usual time, and . . . earned higher scores in a comprehensive welding test” (Snyder, 1984, p. 256). The (false) beliefs of the welding instructor created reality.

The power of self-fulfilling prophecies has been demonstrated in many areas of inquiry. The sociologist Merton introduced the construct in 1948, documenting incidences such as banks that went broke because someone started a rumor that they would go broke. Rosenthal (1966) reviews a spate of studies showing that the expectations of experimenters influence their results. Placebos are among a doctor’s

most powerful medicines. Frank (1961), in his popular book *Persuasion and Healing*, and Aronoff and Lesse (1983) demonstrate how the placebo effect works in psychotherapy: patients who have faith in their therapists and the effects of psychotherapy – “true believers” – are more likely to fulfill their optimistic beliefs by improving than those who do not. These findings have obvious implications for biological adaptation.

Swann (1984) characterizes the self as an “architect of social reality,” and describes three ways in which individuals manipulate their social environments to verify their conceptions of themselves: “They may display signs and symbols of who they are, they may seek out individuals whose appraisals confirm their self-views, and they may adopt interaction strategies that elicit self-confirmatory reactions” (p. 105). In addition, people may attend to information that confirms their self-concept and ignore information that disconfirms it. Intimate relationships are especially important for confirming and stabilizing self-concepts. Swann argues that self-verification is more important than self-enhancement. Thus, individuals may seek to confirm negative self-views because the maintenance of a stable self-concept is more adaptive in predicting and controlling one’s world than the confusion of change.

To summarize, we have argued that false beliefs, especially self-delusions, may be more adaptive than valid self-conceptions for a variety of reasons. Thinking highly of oneself makes one feel good, optimistic, in control, and confident; and these psychological states are fitness-enhancing. Dispositions to construct self-enhancing delusions should prevail over dispositions to perceive oneself validly – but only to a point. Rampant delusions, such as those that define paranoid disorders are maladaptive, not so much because they misrepresent reality but because others refuse to support them. As with deception, the adaptive value of delusions will be mitigated to the extent that they conflict with and are opposed by the delusions of others. Individuals who succeed in inducing others to buy into and endorse their visions – religious leaders such as Christ (who believed he was the Son of God) or Oral Roberts (who believes he has a direct line to God and has raised the dead), charismatic leaders such as Mahatma Ghandi, or demagogues such as Hitler, may be eminently fit. What counts in social exchange is the ultimate effect on individuals’ fitness of the beliefs they harbor, not their validity. If deluding oneself and believing the delusions of others is adaptive, these dispositions will evolve. The result may well be social systems characterized by grand conspiracies – a sort of “you support my delusions, I’ll support yours” exchange. As we negotiate everyday social exchanges, we often are aware of others’ tendency to fool themselves, but it isn’t in our interest to call them on it; we only sour occasions and lose friends. But many of our delusions are shared delusions; they are part of our culture; we are socialized to believe them; and that is adaptive. Shared beliefs foster group cohesiveness, and are self-serving (“We are the chosen

people"). They unite groups against outsiders. Those with different beliefs are viewed as a threat—a primary cause of religious wars and genocide (Becker, 1975).

In conclusion, we suggest that our early social environment selected both valid systems of knowing, the tendency to adopt unexamined beliefs, and a host of self-serving cognitive biases. Because false beliefs are more adaptive in many circumstances than true beliefs, we have evolved into a species of "true believers"—beings who fool ourselves into believing we are what we are not, and are not what we are.

Acknowledgment. We appreciate the comments and criticisms of Jeremy Carpendale, Ray Corrado, Ken Burstein, Cath McFarland, and Ben Slugoski.

REFERENCES

- Alexander, R.D. (1975). The search for a general theory of behavior. *Behavior Science*, 20, 77–100.
- Alexander, R.D. (1979). *Darwinism and human affairs*. Seattle: University of Washington Press.
- Alexander, R.D., and Noonan, K.M. (1979). Concealment of ovulation, parental care, and human social evolution. In N.A. Chagnon and W.G. Irons (Eds.), *Evolutionary biology and human social organization*. North Scituate, MA: Duxbury.
- Alloy, L.B., and Abramson, L.Y. (1982). Learned helplessness, depression and the illusion of control. *Journal of Personality and Social Psychology*, 42, 1114–1126.
- Alloy, L.B., and Abramson, L.Y. (in press). Depressive realism: Four theoretical perspectives. In L.B. Alloy (Ed.), *Cognitive processes in depression*. New York: Guilford.
- Aronoff, M.S., and Lesse, S. (1983). Principles of psychotherapy. In B. Wolman (Ed.), *The therapist's handbook: Treatment methods of mental disorders*. New York: Van Nostrand Reinhold Co.
- Becker, E. (1975). *Escape from evil*. New York: The Free Press.
- Bem, D.J. (1965). An experimental analysis of self-persuasion. *Journal of Experimental Social Psychology*, 1, 199–218.
- Bem, D.J., and McConnell, H.K. (1970). Testing the self-perception explanation of dissonance phenomena: On the salience of premanipulation attitudes. *Journal of Personality and Social Psychology*, 14, 23–31.
- Bowers, K.S. (1987). Revisioning the unconscious. *Canadian Psychology*, 28 (2), 93–104.
- Brown, R., and McNeill, D. (1966). The "tip-of-the-tongue" phenomenon. *Journal of Verbal Learning and Verbal Behavior*, 5, 325–337.
- Bulman, R.J., and Wortman, C.B. (1977). Attributions of blame and coping in the "real world": Severe accident victims react to their lot. *Journal of Personality and Social Psychology*, 35, 351–363.

- Campbell, D.T. (1983). The two distinct routes beyond kin selection to ultrasociality: Implications for the humanities and social sciences. In D.L. Bridgeman (Ed.), *The nature of prosocial behavior*. New York: Academic.
- Cheesman, J., and Merikle, P.M. (1985). Word recognition and consciousness. In D. Besner, T.G. Waller, and G.E. MacKinnon (Eds.), *Reading research: Advances in theory and practice (Vol. 5)*. New York: Academic.
- Damon, W., and Hart, D. (1982). The development of self-understanding from infancy through adolescence. *Child Development*, 51, 831–857.
- Daniels, D. (1983). The evolution of concealed ovulation and self-deception. *Ethology and Sociobiology*, 4, 69–87.
- Darwin, C. (1872). *The expression of emotions in man and animals*. London: Murray.
- Dawkins, R. (1976). *The selfish gene*. London: Oxford University Press.
- Demos, R. (1960). Lying to oneself. *Journal of Philosophy*, 57, 588–595.
- Denton, K., Schroeder, M., and Krebs, D. (1987, January). Hypothetical moral reasoning about others, consequential reasoning involving the self, and moral behavior. Paper presented at the symposium *From moral action to moral judgment and back*. Harvard University, Cambridge, MA.
- Douglas, W.A., and Gibbins, K. (1983). Inadequacy of voice recognition as a demonstration of self-deception. *Journal of Personality and Social Psychology*, 44, 589–592.
- Ekman, P., and Friesen, W.V. (1974). Detecting deception from the body or face. *Journal of Personality and Social Psychology*, 29, 288–298.
- Fenigstein, A. (1983). *Self-consciousness and the overperception of self as a target*. Unpublished manuscript, Kenyon College.
- Fields, J.M., and Schuman, H. (1976). Public beliefs about the beliefs of the public. *Public Opinion Quarterly*, 40, 427–448.
- Fischhoff, B. (1982). For those condemned to study the past: Heuristics and biases in hindsight. In D. Kahneman, P. Slovic, and A. Tversky (Eds.), *Judgment under uncertainty: Heuristics and biases*. New York: Cambridge University Press.
- Fiske, S.T., and Taylor, S.E. (1984). *Social cognition*. Reading, MA: Addison-Wesley.
- Flavell, J.H., et al. (1968). *The development of role-taking and communication skills in children*. New York: Wiley.
- Frank, J.D. (1961). *Persuasion and healing: A comparative study of psychotherapy*. Baltimore: Johns Hopkins University Press.
- Fromkin, H.L. (1972). Feelings of interpersonal undistinctiveness: An unpleasant affective state. *Journal of Experimental Research in Personality*, 6, 178–182.
- Gallup, G.G., Jr. (1977). Self-recognition in primates. *American Psychologist*, 32, 329–338.
- Gardner, H. (1983). *Frames of mind: The theory of multiple intelligences*. New York: Basic.
- Gardner, H. (1986). *The mind's new science: A history of the cognitive revolution*. New York: Basic.
- Gazzaniga, M.S. (1985). *The social brain: Discovering the networks of the mind*. New York: Basic.

- Gibbins, K., and Douglas, W. (1985). Voice recognition and self-deception: A reply to Sackeim and Gur. *Journal of Personality and Social Psychology*, 48, 1369–1372.
- Goethals, G.R. (1986). Fabricating and ignoring social reality: Self-serving estimates of consensus. In J. Olson, C.P. Herman, and M.P. Zanna (Eds.), *Relative deprivation and social comparison: The Ontario symposium on social cognition: IV*. Hillsdale, NJ: Erlbaum.
- Goethals, G.R., and Darley, J.M. (1977). Social comparison theory: An attributional approach. In J.M. Suls and R.L. Miller (Eds.), *Social comparison processes: Theoretical and empirical perspectives*. Washington, DC: Hemisphere.
- Goethals, G.R., and Reckman, R.F. (1973). The perception of consistency in attitudes. *Journal of Experimental Social Psychology*, 9, 491–501.
- Goleman, D. (1986). *Vital lies, simple truths*. Oregon: Touchstone.
- Goleman, D. (1987). Who are you kidding? *Psychology Today*, 21 (3), 24–30.
- Greenwald, A.G. (1980). The totalitarian ego: Fabrication and revision of personal history. *American Psychologist*, 35, 603–618.
- Greenwald, A.G., and Pratkanis, A.R. (1984). The self. In R.S. Wyer, Jr., and T.K. Srull (Eds.), *Handbook of social cognition* (Vol. 3). Hillsdale, NJ: Erlbaum.
- Gur, R.C., and Sackeim, H.A. (1979). Self-deception: A concept in search of a phenomenon. *Journal of Personality and Social Psychology*, 4, 147–169.
- Haan, N. (1983). An interactional morality of everyday life. In N. Haan, R. Bellah, P. Rabinow, and W. Sullivan (Eds.), *Social science as moral inquiry*. New York: Columbia University Press.
- Harvey, J.H., Wells, G.L. and Alvarez, M.D. (1978). Attribution in the context of conflict and separation in close relationships. In J.H. Harvey, W. Ickes, and R.F. Kidd (Eds.), *New directions in attribution research* (Vol. 2). Hillsdale, NJ: Erlbaum.
- Heider, F. (1958). *The psychology of interpersonal relations*. New York: Wiley.
- Higgins, N.C. (1987). Optimism in the hindsight bias: Confidence about past and future outcomes. Unpublished manuscript, Simon Fraser University.
- Hilgard, E.R. (1986). *Divided consciousness: Multiple controls in human thought and action*. New York: Wiley.
- Hocart, A.M. (1952). *The life-giving myth*. London: Methuen.
- Hofstadter, D.R. (1985). *Metamagical themas: Questing for the essence of mind and pattern*. New York: Basic.
- Janoff-Bulman, R. (1979). Characterological versus behavioral self-blame: Inquiries into depression and rape. *Journal of Personality and Social Psychology*, 37, 1789–1809.
- Jaynes, J. (1986). Consciousness and the voices of the mind. *Canadian Psychology*, 27, 128–139.
- Jervis, R. (1976). *Perception and misperception in international politics*. Princeton, NJ: Princeton University Press.
- Kahneman, D. (1986). Toward a psychology of incoherence. Paper presented at the "Conference on Mental Representation," Vancouver, B.C. (February).
- Kelley, H.H. (1967). Attribution theory in social psychology. *Nebraska Symposium on Motivation*, 15, 192–241.

- Kelley, H.H. (1972). Causal schemata and the attribution process. In E.E. Jones, D.E. Kanouse, H.H. Kelley, R.E. Nisbett, S. Valins, and B. Weiner (Eds.), *Attribution: Perceiving the causes of behavior*. Morristown, NJ: General Learning Press.
- Kelly, G.A. (1955). *The psychology of personal constructs* (2 Vols.). New York: Norton.
- Kernis, M.H. (1984). Need for uniqueness, self-schemas, and thought as moderators of the false consensus effect. *Journal of Experimental Social Psychology*, 20, 350–362.
- King, A.S. (1971). Self-fulfilling prophecies in training the hard-core: Supervisors' expectations and the underprivileged workers' performance. *Social Science Quarterly*, 52 (1), 369–378.
- Kirk-Smith, M.D., Van Toller, C., and Dodd, G.H. (1983). Unconscious odour conditioning in human subjects. *Biological Psychology*, 17, 221–231.
- Kirscht, J.F., Haefner, D.P., Kegeles, S.S., and Rosenstock, I.M. (1966). A national study of health beliefs. *Journal of Health and Human Behavior*, 7, 248–254.
- Kobasa, S.C. (1979). Stressful life events, personality, and health: An inquiry into hardiness. *Journal of Personality and Social Psychology*, 37 (1), 1–11.
- Kohlberg, L. (1984). *The psychology of moral development*. New York: Harper and Row.
- Korte, C. (1972). Pluralistic ignorance about student racism. *Sociometry*, 35, 576–587.
- Krebs, D. (1987). The challenge of altruism in biology and psychology. In C. Crawford, M. Smith, and D. Krebs (Eds.), *Sociobiology and psychology: Ideas, issues, and findings*. Hillsdale, NJ: Erlbaum.
- Krebs, D., Schroeder, M., and Denton, K. (1987, January). On the corruption of pure reason in the moral domain. Paper given at the symposium *From moral action to moral judgment and back*. Harvard University, Cambridge, MA.
- Lacey, J.I., and Lacey, B.C. (1973). Experimental association and dissociation of phasic bradycardia and vertex-negative waves. A psychological study of attention and response intention. In W.C. McCallum and J.R. Knott (Eds.), *Event-related slow potentials in the brain*. New York: Elsevier.
- Langer, E.J. (1975). The illusion of control. *Journal of Personality and Social Psychology*, 32, 311–328.
- Langer, E.J., and Rodin, J. (1976). The effects of choice and enhanced personal responsibility for the aged: A field experiment in an institutional setting. *Journal of Personality and Social Psychology*, 34, 191–198.
- Langer, E.J., and Roth, J. (1975). Heads I win, tails it's chance: The illusion of control as a function of the sequence of outcomes in a purely chance task. *Journal of Personality and Social Psychology*, 32, 951–955.
- Larwood, L. (1978). Swine flu: A field study of self-serving biases. *Journal of Applied Social Psychology*, 39, 806–820.
- LeDoux, J.E., Wilson, D.H., and Gazzaniga, M.S. (1979). Beyond commissurotomy: Clues to consciousness. In M. Gazzaniga (Ed.), *Handbook of behavioral neurobiology* (Vol. 2). New York: Plenum.
- Lefcourt, H.M. (1973). The functions of illusions of control and freedom. *American Psychologist*, 28, 417–425.

- Lerner, M.J. (1980). *The belief in a just world*. New York: Plenum.
- Lockard, J.S. (1980). Speculations on the adaptive significance of self-deception. In J.S. Lockard (Ed.), *The evolution of human social behavior*. New York: Elsevier.
- MacLean, P.D. (1973). *A triune concept of the brain and behavior*. Toronto, Canada: University of Toronto Press.
- Malmo, R.B. (1970). Emotions and muscle tension: The story of Anne. *Psychology Today*, 3, 64–67.
- Marcel, A.J. (1983). Conscious and unconscious perception: An approach to the relations between phenomenal experience and perceptual processes. *Cognitive Psychology*, 15, 238–300.
- Markus, H. (1977). Self-schemata and processing information about the self. *Journal of Personality and Social Psychology*, 35, 63–78.
- Maynard Smith, J. (1976). Evolution and the theory of games. *American Scientist*, 64, 41–45.
- McFarland, C., and Ross, M. (1982). Impact of causal attributions on affective reactions to success and failure. *Journal of Personality and Social Psychology*, 43, 937–946.
- Menzel, E.W., Jr. (1974). A group of young chimpanzees in a one-acre field. In A.M. Schrier and F. Stollnitz (Eds.), *Behavior of nonhuman primates* (Vol. 5). New York: Academic.
- Merton, R.K. (1948). The self-fulfilling prophecy. *Antioch Review*, 8, 193–210.
- Miller, D.T. (1976). Ego involvement and attributions for success and failure. *Journal of Personality and Social Psychology*, 34, 901–906.
- Miller, D.T., and Ross, M. (1975). Self-serving biases in the attribution of causality: Fact or fiction? *Psychological Bulletin*, 82, 213–225.
- Mitchell, R.W. (1986). A framework for discussing deception. In R.W. Mitchell and N.S. Thompson (Eds.), *Deception: Perspectives on human and non-human deceit*. Albany: State University of New York Press.
- Mullen, B., Atkins, J.L., Champion, D.S., Edwards, C., Hardy, D., Story, J.E., and Vanderklok, M. (1985). The false consensus effect: A meta-analysis of 115 hypothesis tests. *Journal of Experimental Social Psychology*, 21, 262–283.
- Murphy, J.M., and Gilligan, C. (1980). Moral development in late adolescence and adulthood: A critique and reconstruction of Kohlberg's theory. *Human Development*, 23, 77–104.
- Nisbett, R., and Ross, L. (1980). *Human inference: Strategies and shortcomings of social judgment*. Englewood Cliffs, NJ: Prentice-Hall Inc.
- Ojemann, G. (1979). A review of the neurologic basis of human cognition, with special emphasis on language. *Allied Health and Behavioral Sciences*, 1, 341–384.
- Perloff, L.S. (1983). Perceptions of vulnerability to victimization. *Journal of Social Issues*, 39, 41–61.
- Perloff, L.S., and Fetzer, B.K. (1986). Self-other judgments and perceived vulnerability to victimization. *Journal of Personality and Social Psychology*, 50 (3), 502–510.
- Peterson, C., and Seligman, M.E.P. (1984). Causal explanations as a risk factor for depression: Theory and evidence. *Psychological Review*, 91, 347–374.

- Pyszczynski, T., Greenberg, J., and LaPrelle, J. (1985). Social comparison after success and failure: Biased search for information consistent with a self-serving conclusion. *Journal of Experimental Social Psychology*, 21, 195-211.
- Rodin, J., and Langer, E.J. (1977). Long-term effects of a control-relevant intervention with the institutionalized aged. *Journal of Personality and Social Psychology*, 35, 897-902.
- Rosenthal, R. (1966). *Experimenter effects in behavioral research*. New York: Appleton-Century-Crofts.
- Ross, L. (1977). The intuitive psychologist and his shortcomings: Distortions in the attribution process. In L. Berkowitz (Ed.), *Advances in experimental social psychology* (Vol. 10). New York: Academic.
- Ross, L., Greene, D., and House, P. (1977). The "false consensus effect": An egocentric bias in social perception and attribution processes. *Journal of Experimental Social Psychology*, 13, 279-301.
- Ross, L., and Shulman, R.F. (1973). Increasing the salience of initial attitudes: Dissonance versus self-perception theory. *Journal of Personality and Social Psychology*, 28, 138-144.
- Ross, M. (1981). Egocentric biases in attributions of responsibility: Antecedents and consequences. In E.T. Higgins, C.P. Herman, and M.P. Zanna (Eds.), *Social cognition: The Ontario symposium* (Vol. 1). Hillsdale, NJ: Erlbaum.
- Ross, M., and Fletcher, G.J.O. (1985). Attribution and social perception. In G. Lindzey and E. Aronson (Eds.), *The handbook of social psychology* (3rd ed.). New York: Random House.
- Ross, M., McFarland, C., Conway, M., and Zanna, M.P. (1983). The reciprocal relation between attitudes and behavior recall: Committing people to newly formed attitudes. *Journal of Personality and Social Psychology*, 45, 257-267.
- Ross, M., McFarland, C., and Fletcher, G.J.O. (1981). The effect of attitude on the recall of personal histories. *Journal of Personality and Social Psychology*, 40, 627-634.
- Ross, M., and Sicoly, F. (1979). Egocentric biases in availability and attribution. *Journal of Personality and Social Psychology*, 37, 322-337.
- Sackeim, H.A., and Gur, R.C. (1985). Voice recognition and the ontological status of self-deception. *Journal of Personality and Social Psychology*, 48, 1365-1368.
- Seligman, M.E.P. (1987). Learned helplessness and depression. Invited address given to the Psychology Department, The University of British Columbia, Vancouver, B.C. (March).
- Selman, R.L. (1980). *The growth of interpersonal understanding*. New York: Academic.
- Sherman, S.J., and Corty, E. (1984). Cognitive heuristics. In R.S. Wyer and T. Srull (Eds.), *Handbook of social cognition*. Hillsdale, NJ: Erlbaum.
- Snyder, M. (1984). When belief creates reality. *Advances in experimental social psychology* (Vol. 18). New York: Academic.
- Sperry, R.W. (1969). A modified concept of consciousness. *Psychological Review*, 76, 532-536.
- Spiegel, D. (1987). The healing trance. *The Sciences*, March/April.
- Swann, W.B. (1984). The self as architect of social reality. In B. Schlenker (Ed.), *The self and social life*. New York: McGraw-Hill.

- Swann, W.B., Jr., and Read, S.J. (1981a). Acquiring self-knowledge: The search for feedback that fits. *Journal of Personality and Social Psychology*, 41, 1119–1128.
- Swann, W.B., Jr., and Read, S.J. (1981b). Self-verification processes: How we sustain our self-conceptions. *Journal of Experimental Social Psychology*, 17, 351–372.
- Symons, D. (1987). If we're all Darwinians, what's the fuss about? In C. Crawford, M. Smith, and D. Krebs (Eds.), *Sociobiology and psychology: Ideas, issues, and findings*. Hillsdale, NJ: Erlbaum.
- Tetlock, P.E. (1984). Toward an intuitive politician model of attribution processes. In B. Schlenker (Ed.), *The self and social life*. New York: McGraw-Hill.
- Thompson, S.C., and Kelley, J.J. (1981). Judgments of responsibility for activities in close relationships. *Journal of Personality and Social Psychology*, 41, 469–477.
- Tiger, L. (1979). *Optimism: The biology of hope*. New York: Simon and Schuster.
- Trivers, R.L. (1972). Parental investment and sexual selection. In B. Campbell (Ed.), *Sexual selection and the descent of man*. Chicago: Aldine.
- Trivers, R.L. (1974). Parent-offspring conflict. *American Zoologist*, 14, 249–264.
- Trivers, R. (1985). *Social evolution*. Menlo Park, CA: The Benjamin/Cummings Publishing Company, Inc.
- Trotter, R.J. (1987). Stop blaming yourself. *Psychology Today*, 21 (2), 30–39.
- Tversky, A., and Kahneman, D. (1971). The belief in the “law of small numbers.” *Psychological Bulletin*, 76, 105–110.
- Tversky, A., and Kahneman, D. (1980). Causal schemas in judgments under uncertainty. In M. Fishbein (Ed.), *Progress in social psychology*. Hillsdale, NJ: Erlbaum.
- Wallace, B. (1973). Misinformation, fitness, and selection. *American Naturalist*, 107, 1–7.
- Weiner, B., Frieze, I., Kukla, A., Reed, L., Rest, S., and Rosenbaum, R.M. (1972). Perceiving the causes of success and failure. In E.E. Jones, D.E. Kanouse, H.H. Kelley, R.E. Nisbett, S. Valins, and B. Weiner (Eds.), *Attribution: Perceiving the causes of behavior*. Morristown, NJ: General Learning Press.
- Weinstein, N.D. (1980). Unrealistic optimism about future life events. *Journal of Personality and Social Psychology*, 35, 270–293.
- Weinstein, N.D. (1983). Reducing unrealistic optimism about illness susceptibility. *Health Psychology*, 2, 11–20.
- Weiskrantz, L., Warrington, E.K., Sanders, M.D., and Marshall, J. (1974). Visual capacity in the hemianopic field following a restricted occipital ablation. *Brain*, 97, 709–728.
- Werth, L.F., and Flaherty, J. (1986). A phenomenological approach to human deception. In R.W. Mitchell and N.S. Thompson (Eds.), *Deception: Perspectives on human and non-human deceit*. Albany: State University of New York Press.
- Zuckerman, M., Kernis, M.H., Guarnera, S.M., Murphy, J.F., and Rappoport, L. (1983). *The egocentric bias: Seeing oneself as cause and target of other's behavior*. Unpublished manuscript, University of Rochester.

5

Sociobiology and the Cognitive-Developmental Tradition in Moral Development Research

KEVIN B. MACDONALD

The purpose of this essay is to review the literature in the cognitive-developmental tradition of moral development research from the standpoint of sociobiological theory. Several propositions based on sociobiological theory will be examined by reviewing presently available data in the field of developmental psychology.

Implicit in this program is the idea that sociobiological theory, as a theory of the ultimate causes of behavior, is consistent with a variety of proximal mechanisms. Nevertheless, sociobiologists have made specific proposals regarding the importance of self-interest versus self-sacrifice in human behavior (see, for example, Alexander, 1979), and some of these statements make poor bedfellows with some of the statements found in the developmental literature. Although sociobiology is consistent with a variety of proximal mechanisms explaining behavior, it is expected roughly that humans, as survival mechanisms, will in fact generally act in order to maximize their self-interest. Thus, it is expected minimally that in studies manipulating self-interest versus the interest of others there will be an important and powerful main effect of self-interest. Regarding the relation of moral beliefs, moral reasoning, and other ideological factors to behavior, a sociobiologist would emphasize that individuals generally believe what is in their self-interest (e.g., Wilson, 1978), but they would also emphasize the role of deception, both of others and of oneself, in moral action. Moral reasoning, as many psychologists in the behaviorist tradition have argued (see Staub, 1978, for a review) would emerge as an epiphenomenon masking self-interest. As Krebs, Schroeder, and Denton (1987) point out, the evolutionary perspective would be more consistent with a model in which "people are cast as self-servers, denying, distorting, fabricating, negotiating and controlling information in a way that satisfies their own ends," rather than with the model of people as rational, objective decision makers (see also Krebs, Denton, & Higgins, this vol., Chap. 4).

Thus far we have emphasized the importance of self-interest in generating sociobiological predictions. Self-sacrifice or altruism is also a prominent theme in sociobiological writings, but it is important to place these issues in perspective. Altruism occupies such a central place in theoretical sociobiology precisely because its existence is so problematic. Evolutionary theory has never had any difficulty with the proposition that the behavior of animals is self-interested. The problems have arisen because some behavior appears not to be self-interested. Various adaptive explanations for such behavior, ranging from kin selection to group selection, have appeared, but the point here is that it is easy to lose sight of the centrality of self-interest in sociobiological theory. Indeed, kin selection and reciprocity, the most agreed-on mechanisms posited to explain altruism from an evolutionary viewpoint, clearly involve self-interest. However, when developmental psychologists wish to posit biologically programmed sources of behavior, they are much more likely to posit empathy or altruism as having an instinctive basis than self-interest or aggression (see, e.g., Hoffman, 1982; Zahn-Waxler & Radke-Yarrow, 1982).

This points to a problem in sociobiological theory in connection with making predictions relevant to psychology. There is theoretical reason to develop, on the one hand, hypotheses in terms of self-interest and deception, and on the other hand, hypotheses in terms of the adaptiveness and innateness of altruistic behaviors. The problem is especially difficult since innate tendencies towards altruism which were adaptive in the context of small, kinship-based societies may not be adaptive in modern societies which are not based on kinship relationships (MacDonald, 1984), and Alexander (1979) proposes that altruistic feelings among unrelated children may develop simply because the children are reared together, attend the same schools, etc. Thus the genetic program for altruism could be deceived by contemporary social structure just as the genetic mechanisms underlying mate selection in some birds can result in maladaptive behavior if the animal is reared by a human. Arguments on the adaptiveness of altruism or self-interest are thus especially difficult.

The schizophrenic nature of the implications of evolutionary theory for thinking about human social behavior was noted by Campbell (1965) many years ago: Egoism and altruism may both be part of the human genetic makeup. This situation need not be debilitating as far as developing the implications of theory is concerned, however. In the present case the main effort will be to find support for what may be called the self-interested side of the implications of evolutionary theory, since this aspect of the picture has not received the attention it deserves within developmental psychology. However, in exploring this evidence it will at times be necessary to discuss data that are not in accord with these

hypotheses, and examples of behavior motivated by the selfless application of moral reasoning will be presented.

The cognitive developmental tradition in the study of moral development has been overwhelmingly influenced by the writings of Piaget. The emphasis has been on the development of reasoning about moral issues and to a lesser extent on the relation between moral reasoning and behavior. Lawrence Kohlberg has been the main recent proponent of a Piagetian approach to moral reasoning, and his theory contains very strong statements of the processes involved. According to Kohlberg (see, for example, Kohlberg, 1984) moral reasoning develops in a series of six stages. These stages parallel the stages of logical thought described by Piaget and these logical stages are viewed as necessary but not sufficient for the similar level of moral development. Regarding the crucial question of motivation, only the preconventional levels are truly self-interested. Stage 1 individuals simply avoid punishment and acknowledge the superior power of authorities, while stage 2 individuals are motivated to serve their own interests by engaging in reciprocal relationships with others. Beyond these stages self-interest is submerged to various considerations, including the opinion of others (stage 3), the good of society (stage 4), the welfare of all individuals (stage 5), and universal moral principles (stage 6).

As indicated above, the relation between moral reasoning and moral action is central to a sociobiological analysis. A sociobiological perspective need not question the essentials of a cognitive-developmental viewpoint. Children may, indeed, be observed to go through the stages of moral reasoning in much the way that Kohlberg and others have found. A sociobiological viewpoint need not question the epigenetic mechanisms proposed by Kohlberg and Piaget to account for progress through the stages of cognitive development. From a sociobiological perspective, however, it would be surprising indeed if there were universal tendencies to both achieve advanced levels of moral reasoning and to act in a manner that was objectively more just, i.e., less self-interested and more able to give equal weight to the claims of others, than at previous stages.

Seven Sociobiological Propositions

Seven propositions consistent with the sociobiological viewpoint sketched above will be considered.

1. Children's behavior is generally self-interested.
2. Individuals alter their level of moral reasoning depending on a variety of contextual considerations, such as the cost to the actor and whether it is the self (or relative or friend) or a hypothetical person (or

stranger or enemy) who will suffer the negative consequences of doing the morally correct thing.

3. There is a weak link between moral reasoning and actual moral behavior, and the best examples of a strong link are cases of minimal cost to the actor.
4. Individuals are often engaged in an effort of self-deception. This proposition emphasizes the self-justificatory aspect of moral reasoning. Individuals who are adept at moral reasoning (i.e., perform at the higher stages) are better able to provide reasons which rationalize their self-interested actions in a manner that would justify their behavior to other individuals. Such reasoning would be more objective in the sense that it would appeal to unbiased, neutral observers.
5. Individuals may not deceive themselves at all, but rather engage in a cynical charade in which their true motives remain hidden from public view while their self-serving actions are described as resulting from very high levels of motivation.
6. Individuals sometimes accept the structure of a moral argument and the choice that it dictates but nevertheless refuse to do the moral thing.
7. Cross-cultural evidence points to the lack of universality of Kohlberg's moral stages (except for the lowest stages) and points to the importance of self-interest, reciprocity, and personal relationships in the moral reasoning of traditional societies (i.e., stages 1–3).

These seven propositions are not mutually exclusive, and in the following discussion I will review evidence for each of them.

1. THE GENERAL IMPORTANCE OF SELF-INTEREST IN CHILDREN'S BEHAVIOR

Developmental psychologists have not framed research questions in terms of the development of selfishness. Instead research has been conducted in the name of attempting to say something about the development of altruism or the development of morality. In a sense, this massive industry attests to the importance of self-interest in children, since hundreds of studies have been performed which show that self-interest can be modified in one way or another if not eradicated completely. Self-interest is usually shown to be present in the baseline condition, its presence assumed and unexplained. One of the consistent findings in the psychological literature on altruism is that sharing and helping can be increased with appropriate reinforcement (see, e.g., Fischer, 1963 and Rushton & Teachman, 1978; Bar-Tal, Raviv, & Leiser, 1980; see Rushton, 1978, for a review). In other words, one way of getting individuals to share more and help others is to provide contingencies so

that such behavior is in their self-interest. Indeed, some theorists reject the use of the word *altruism* for sharing and helping behaviors because they do not want to exclude the possibility of external reinforcement in maintaining these behaviors (e.g., Gelfand & Hartmann, 1982). In psychological experiments on altruism, self-interest emerges strongly in the baseline conditions and remains even after the treatment condition, although its effects are at least temporarily weaker. Although this essay is mainly concerned with work in the cognitive-developmental tradition, in this section work in the social learning tradition on altruism is included in order to address the question of the general importance of self-interest in children's behavior.

In a highly influential work, Damon (1977) provides evidence that self-interest is an important component of children's choice behavior under conditions where the choice has important consequences in the eyes of the children. The children, aged 4 to 10, were presented with an opportunity to divide candy bars among themselves and three other individuals who had participated in a bracelet-making session. One of the children was designated as having made the most and the prettiest bracelets, one as being the biggest child, and one as being the nicest, and in addition there was one younger child whose performance on the bracelet-making task was inferior to the others. Children in each of the three designated positions tended to give more to themselves than others were willing to give to that position when they were in a different position. Moreover, there was no tendency for older children to give more to the younger, less competent child.

Numerous studies have been performed on children's generosity in laboratory situations and, although not all of these studies can be reviewed here, an attempt will be made to discuss representative findings. For example, Rushton (1982) reviews his own work indicating that children will donate from 14% to 42% (25% average – Rushton, 1980) of their winnings in a bowling tournament to needy children, depending on age. In other studies the baseline rates of donating are far lower. White (1972) found that control children who had won 12 nickels donated an average of .57 nickels to charity. Bryan and Walbek (1970) allowed children to win 30 1-cent gift certificates and found that 41% to 69% of the children made no donations at all, including children in the treatment conditions. Rice and Grusec (1975) found that control children who had won 20 marbles donated between 0 to 1.5 marbles to other children, while Eisenberg-Berg and Gershaker (1979) found that control children who won 10 nickels donated an average of .09 nickels to needy children. Grusec, Saas-Kortsak, and Simutis (1978) and White and Burnham (1975) found that subjects in a control condition made no donations at all. Clearly the baseline performances of children in social learning experiments is often quite low.

Modeling is one of the means by which prosocial behavior has been increased, and since it is central to the social learning tradition, the

results of this influence will be discussed here. Staub (1978) characterizes the results of laboratory studies as indicating that "(a)lthough . . . the effect of modeling was usually significant, often it was not substantial" (p. 201). For example, Grusec et al. (1978) found that under the most favorable condition of modeling and moral exhortation children donated an average of 3.62 colored pencils out of the 12 they had been given. Eisenberg-Berg and Gersheker (1979) found that a competent, generous model increased donating from near 0 nickels to an average of 2.64 out of the 10 they had won. Bryan and Walbek (1979) found that a familiar, powerful model who preaches charity and acts charitably resulted in children's donating 33% of their winnings, and White (1972) found a similar level in a situation in which subjects were told to donate in practice games (guided rehearsal). In other cases the modeling raised donations to around 50% (Rice & Grusec, 1975; Rushton, 1980).

These results indicate that modeling can have important effects on altruistic behavior but also indicate an important residue of self-interest and resistance to modeling. Rarely, if ever, do the subjects of the experiment donate as much as the model, and the results generally decline on retesting (e.g., White, 1972; Rushton & Littlefield, 1979), although they may not disappear.

On the other hand, these results may be interpreted to indicate the methods whereby the socialization of altruism occurs in the real world rather than expecting overwhelming results from a laboratory manipulation (e.g., Rushton, 1982). Rushton (1980, 1982) has shown that there are consistent, stable individual differences in altruism, and these may in fact be the result of prolonged socialization involving modeling and other influences. Nevertheless, the above data indicate that baseline rates of donating in laboratory situations are really quite low on the average, so that producing extremely altruistic individuals must not be all that common, at least in our culture. Finally, it should be noted also that the behaviors studied are really of very little cost to the subject, presumably unmeasurable in terms of biological fitness, and that even here there is a very strong influence of self-interest. As indicated below, if the behaviors involved were of much greater importance to the subject we would expect to see even less altruism.

2. DIFFERENCES BETWEEN HYPOTHETICAL AND REAL-LIFE MORAL REASONING: THE ROLE OF SELF-INTEREST

A sociobiological approach must be contextual, because it must emphasize features such as the cost to the actor and the relationships of the people involved in order for a decision to be made rather than being solely concerned with the abstract justice principles involved. Indeed, cost-benefit analysis is a fundamental feature of theories in evolutionary biology and behavioral ecology (Wilson, 1975). Moreover, sociobiol-

ogy predicts that a major consideration in real-life moral reasoning is the genetic relatedness of the individuals in the moral situation: All things being equal, it is expected that individuals will reason in a more self-interested manner about themselves and their relatives than strangers, enemies, or hypothetical story characters.

Damon's (1977) data, discussed above, also show that there is a gap between hypothetical and real-life moral reasoning, a gap which is caused by self-interest. Real-life moral reasoning in a situation in which candy bars were apportioned resulted in lower average scores for moral reasoning than reasoning about what one would do in a hypothetical situation. These results might have been more clear-cut, except that the situation was constructed in such a way that in some cases self-interest could result in higher levels of moral reasoning. With age partialled out, the correlation between hypothetical and real-life reasoning was only .26, and the author notes that this may have been due to practice effects since each child engaged in both types of reasoning. Damon ascribes the lower reasoning to the intrusion of self-interest in the real-life situation.

The data of Haan (1978) also illustrate the different types of reasoning found in situations depending on the degree of self-interest present. Haan (1978) performed a study in which adolescents were interviewed regarding their formal (Kohlbergian) and interpersonal morality. In addition, the teenagers, who formed naturally occurring groups, played several games as part of the group. The games varied in the degree to which they resulted in animosity among the participants, with two games in particular, a version of Prisoner's Dilemma and Starpower, eliciting the most negative interactions. The Prisoner's Dilemma game resulted in high amounts of anger, competition, group pressure on individuals, and low ratings for group solidarity and sociability. The Starpower game resulted in differences in status and power within the group and was characterized by status divisiveness, domination, and depression among the group members.

Interviews generally resulted in much higher percentages of formal, intellectual reasoning than did the actual games, which tended to elicit interpersonal styles of reasoning. Formal and interpersonal styles were more divergent for older teenagers than younger. There were few associations between interview and action-based moralities, so that interviews were poor predictors of action. The author argues for the specificity of moral reasoning strategies. Prisoner's Dilemma and Starpower resulted in the lowest levels of both formal and interpersonal morality, reflecting an inverse relation between moral reasoning and the degree of stress experienced by participants. Formal reasoning was particularly affected by situations: It dropped precipitously under situations of stress and soared "in pleasant situations in which verbalizations could be cheaply produced" (p. 297). "Undoubtedly the stress evoked by the unjust and oligarchical structure of Starpower, which

determined which individual teenagers were to control or be controlled by others, especially disrupted the relationships between interview- and action-based levels" (p. 300). In a passage that presages Gilligan (see below), she states that:

Formal morality is an attempt to rise above the details of the occasion, discern the general rule, and then apply this rule, logically, impersonally, and ideally. Thus we can see that the formal system is remote from situations and that it results in less impressive predictions of action levels but more impressive predictions within interviews, where this kind of strategy is probably more functional (p. 300–301).

Regarding moral reasoning in general, she states that "probably no other kind of human functioning is as easily and frequently disrupted by self-deceptiveness" (p. 302–303). Moreover, in a previous work (Haan, 1977) she finds that adults who habitually use the defensive strategies of intellectualizing and denial had higher interview-based formal scores, suggesting that "formal reasoning can be an intellectualized exercise that is quite removed from the situation and the special needs of the persons involved" (Haan, 1978, p. 303). She characterizes Kohlbergian moral reasoning as involving "special, highly organized, abstract intersubjective meanings that are learned in the process of being formally educated."

Consistent with this general finding of the contextual sensitivity of moral reasoning, Sobesky (1983) found that specifying consequences in a hypothetical situation strongly affects moral reasoning. This can be seen in the classic Kohlbergian dilemma involving the question of whether the hypothetical Heinz should steal a drug which will save his wife's life. If subjects are told that there would be severe consequences to Heinz if he were caught, there is a tendency to reason at a lower level than if the consequences for Heinz were mild. When the consequences to Heinz were said to be severe, the subjects preferred preconventional ways of solving the moral dilemma. Leming (1978) found that adolescents reasoned at a higher level if the individual in the moral dilemma was described as a hypothetical stranger (e.g., Heinz) than when the dilemma was said to be about the subject himself. In addition, the subjects showed lower levels of moral reasoning (an increase in stage 2 responses and a decrease in stage 3 responses) when discussing practical and moral issues that occurred in the subjects' daily lives or in which they themselves were the focus of the dilemma than when discussing the classical Kohlbergian dilemmas. Levine (1976) found that compared to the situation in which the protagonist of the story was said to be a same-sex friend, there was an increase in stage 3 reasoning and a decrease in stage 4 reasoning when the protagonist of the stories was said to be either the subject's mother or the subject's best friend. Finally, Eisenberg-Berg and Neal (1981) found that subjects asked to imagine

themselves as central characters in a story used significantly more hedonistic reasoning and less needs-oriented reasoning than when told that the subject of the story was simply a same-sex person. In addition, when the cost of an altruistic act in the story was high, there was more hedonistic reasoning and less needs-oriented reasoning.

These examples illustrate the importance of contextual influences on moral reasoning and behavior consonant with the general importance of self-interest and relatedness in human behavior. Reasoning about oneself, one's relatives, and significant others is done with a different calculus than is reasoning about hypothetical situations, and the results of Gilligan (1977, 1982; see below) support this. Reasoning also becomes less moral and more hedonistic when the stakes in the dilemma are increased, presumably because the individual is performing a cost-benefit analysis of the situation and then attempting to justify the results with appropriate moral reasoning.

3. THE LINK BETWEEN MORAL REASONING AND MORAL BEHAVIOR

Given that children do engage in moral reasoning in the manner proposed by the cognitive-developmentalists, what is the link with moral behavior? Although there is some evidence for a link between moral reasoning and moral behavior, the linkage is weak. Rest (1983) notes that subjects may differ in the ways that they apply the reasoning of their developmental level to a problem, differ in the degree to which religious and other doctrines result in different judgments of fairness, as well as differ in their interpretation of a situation as moral, their decision as to what the most appropriate action in the situation should be, and their actually performing the action. "Moral judgment is one player in a large cast of players, and even if it is a star, it is not the whole show" (p. 600). Rest (see also Blasi, 1980) also points out that some of the behaviors studied in attempts to discover the links between moral reasoning and moral behavior (smoking marijuana, being a virgin) are of questionable moral significance. In addition, there is no assurance that the verbal schemes a person uses in a hypothetical situation are operative in real situations. Moreover, in many cases the behaviors studied are actually attitudes, such as opinions on Lt. Calley, the Watergate defendants, or some other public policy issue. The behaviors studied are of very slight cost to the performer, such as voting, helping an apparently drugged student get medical assistance, or simply verbal acceptance of responsibility. In such cases there is little reason for one not to act in accord with one's stated moral beliefs. Even using measures such as these, Blasi (1980) found that only 57 of 75 studies assessing these relationships reported significant results, and the significant

results were quite weak. Many of these studies are unpublished doctoral dissertations of unknown quality.

In addition, it should be pointed out that although there may be a connection between the structure of moral reasoning and moral choice in some of the hypothetical dilemmas proposed by Kohlberg, the fact that some dilemmas do not yield unanimity of moral choice even at stage 5 makes it unclear to what extent in real-life dilemmas individuals of even the advanced moral stages can simply justify their self-interest with their moral reasoning. If stage 5 individuals can easily disagree on what is the moral course of action in real-life dilemmas, the sociobiological hypothesis that moral reasoning is simply a rationalization for self-interested behavior becomes a real possibility.

The importance of a cost-benefit analysis in considering the relationships between moral reasoning and moral behavior is evident in some of the studies described by Kohlberg and others as supporting the theory of a strong link between moral reasoning and moral behavior. Thus Kohlberg and Candee (1984) discuss the work of Helkama (1979) which shows that in response to the Heinz dilemma, higher stages of moral reasoning are associated with (a) the belief that Heinz should steal the drug (b) the belief that Heinz is responsible if he does not steal the drug and his wife dies, and (c) the percentage who think Heinz should steal who hold him responsible. McNamee (1978) staged a situation in which the subject witnesses a scene in which a person who is purportedly under the influence of drugs asks for and is denied help from a research psychologist. At higher stages of moral reasoning the subject is more likely to think he/she should help, more often helps by providing information to the victim, and more often personally intervenes. Moreover, there is increasing consistency between thinking one should help with actually helping by referring the drugged person to some sort of medical care. Blasi (1983) found that at higher stages of moral reasoning there was more consistency between ascribed judgments of what was right and accepting responsibility to act in accordance with those judgments. Older subjects were able to say that the agent in a hypothetical story had a responsibility to act on his/her beliefs rather than to simply accept a gap between what the person thinks is morally correct and what one ought to do. Rholes and Bailey (1983) found that individuals who were higher in moral reasoning mailed in a petition supporting their views on abortion more often and more often signed up to perform service activities relevant to abortion than individuals with a lower level of moral reasoning independent of the strength of their attitude toward abortion. Finally, Kohlberg and Candee (1984) found that at higher moral stages more individuals who thought it was right to sit in to protest restrictions on free speech actually did so. They also found that at higher stages of moral reasoning

individuals were less likely to continue shocking an experimental subject on instructions from an experimenter.

Regarding the first of these studies (Helkema, 1979), a sociobiological critique would emphasize the lack of real consequences for the subject. The dilemma is hypothetical and the judgments of responsibility have no real import for the subject. Despite this, at stage 5 only 67% think Heinz should steal the drug, only 53% think that Heinz is responsible if he steals the drug and the wife dies, and 50% of those who think he should steal the drug also hold him responsible. Thus, even in a hypothetical situation, significant numbers of individuals display lack of consistency between deontic judgments and judgments of responsibility. The McNamee (1978) data also involve a situation of minimal cost to the subject. Even though intervention consisted only of taking the person to a source of help, only 20% of the stage 5 individuals offered such assistance, and none of the previous three stages did so. The even more painless behavior of providing information was shown by 73% of the stage 5 subjects. The Blasi (1983) study was completely hypothetical and involved no cost at all to the subject. Lack of cost to the subject also figures in the Rholes and Bailey study: Rholes and Lane (1985) comment that one of the drawbacks of the study was that the behaviors asked of the subjects were relatively "cost free." Regarding the Kohlberg and Candee studies, although the negative consequences of sitting in are not discussed, it presumably did not in fact involve any substantial loss and presumably was socially acceptable within the group of students who sat in.

In general these results show that in circumstances of little or no cost to the subject there will be a tendency for higher-stage subjects to give more aid. The study by McNamee (1978) is particularly interesting since the two measures of moral behavior differ in cost to the subject. Even at stage 5, which is the highest empirically realized stage in Kohlberg's present scheme, there is a huge decrease in the number of individuals giving assistance when the cost of the behavior is relatively high. Providing actual assistance occurred at a much lower rate than simply providing information, even though none of the helping behaviors mentioned were really anything more than temporary inconveniences to the subjects. They were fairly low-cost behaviors, certainly far less costly than the effects of decisions confronted by Gilligan's subjects described below.

It should also be pointed out that the data showing significant instances of morally correct behavior from individuals, especially at higher stages of moral reasoning, are quite consistent with a sociobiological perspective. In situations of very low cost it may benefit individuals to both behave in the morally correct manner and reason at a high-stage level. Such individuals lose little or nothing and gain the respect and admiration of others, not only for their actions but also for

their moral character. Philanthropy (literally "love of man") by otherwise rapacious businesses and wealthy individuals is good public relations, if you can afford it. Worchel (1984) points out that power is often a motive for helping others and presumably also for behaving in a morally laudable manner: "(t)he message, often explicit, in charity drives is that powerful and fortunate people should support the less powerful and unfortunate others. Donating to such a charity, therefore, implies that the donor is to be counted among the powerful" (p. 382). Although not claiming that this is the only motive behind helping behavior, he suggests a profit motive behind helping behavior not just in the case where reciprocation is a possibility, but because the donor gains power simply by helping. Data are discussed indicating that for many individuals accepting help is aversive and that the reason for this is the loss of power implied in such a relationship.

Finally, sociobiological theory is consistent with ongoing natural selection against individuals who act in a completely selfless manner for whatever reason, including high-stage moral reasoning. Celibate religious personnel, suicide bombers, individuals who die attempting to rescue others, or individuals (if any such exist) who voluntarily accept exploitation by others may simply be selected against, assuming of course that these actions do not in fact help relatives. Evolution is an ongoing enterprise. Although Wilson (1978) is undoubtedly correct in supposing that individuals tend to believe what is in their best interests, there are notorious and historically important situations where this is not the case (MacDonald, 1983).

4. MORAL REASONING AS JUSTIFICATION OF SELF-INTEREST

Assuming a weak link at best between moral reasoning and moral action, it then becomes relevant to ask whether in fact individuals engage in moral reasoning as an attempt to justify self-interest. It should be pointed out that in addition to being associated with greater verbal comprehension, moral reasoning is also moderately correlated with IQ (Rest, 1979) and with education (Rest & Thoma, 1985). Moreover, there is a consistent finding of strong associations between IQ, postconventional moral reasoning, and opposition to conservative-authoritarian political values (Rest, 1979). These results suggest that to some extent advanced moral reasoning is the prerogative of the intelligent, the educated, and the verbally fluent, results that are quite consistent with the idea that moral reasoning represents little more than the justification of self-interest. Kohlberg's theory must be said to imply that individuals with more intelligence and education not only reason in a more advanced manner but also behave in a more advanced manner, given the strong link between reasoning and behavior that he proposes. Are lawyers and philosophers, two of the highest scoring groups on tests

of moral reasoning, really better people or just better able to provide reasons that would appeal to objective, non-self-interested observers than individuals in other occupations? Since providing good, objective reasons is the essence of these occupations, great skill at moral reasoning is not surprising. A strong connection to behavior would be.

The work of Carol Gilligan is of interest in regard to the question of the rationalization of self-interest because she has chosen to study a situation with very high cost to the individuals involved. Gilligan (1982; see also Gilligan, 1977) contrasts the hierarchical, logical, aggressive mode of reasoning with a method which focuses on networks, communication, and relationships. Women's judgments are based more on empathy and compassion. Women therefore are classed more as children in Kohlberg's scheme, although both Rest (1983) and Kohlberg (1984) find no tendency for women to score differently on the standard tests of moral reasoning. According to Gilligan, women define problems in terms of care and responsibility in relationships rather than rights and rules. Women are torn between selfishness and responsibility. The basis for these claims is a study in which women were interviewed concerning their reasons for considering abortion. From a sociobiological point of view, this paradigm is quite promising because it deals with a very real crisis in a person's life, rather than with hypothetical dilemmas of no real concern to the subject.

The interview material quite clearly shows that these women often considered the decision to have major effects on their lives as well as major effects on other individuals in their lives, such as lovers, husbands, and parents. The actual case material shows individuals often torn between self-interest and the feelings of others, and, less commonly, moral principles relating to the value of the life of the unborn child. Survival is mentioned quite often as the motive for abortion: "preservation of oneself, I think, is the most important thing. It comes before anything in life" (Betty, age 16; p. 76). Josie states, "I see myself as becoming more mature in ways of making decisions and taking care of myself, doing something for myself." For Ann the issue also is survival and looking out for herself. Gilligan finds a tendency to proceed from a selfish mode to a responsible mode and back to a selfish mode, and she claims this new selfishness is "not only honest but fair" (p. 85). The woman verifies the legitimacy of her own judgment and her own point of view as "(S)urvival returns as the paramount concern" (p. 87).

For many of the women there is a very tortured path of reasoning which sometimes involves self-deception and in the end justifies their actions. Gilligan emphasizes the creative aspect of moral reasoning in which the subject attempts to frame the situation in a manner which will allow her to justify her actions. Gilligan states that in the early stage of reasoning,

Self-assertion falls prey to the old criticism of selfishness. Then the morality that condones self-destruction in the name of responsible care is not repudiated as inadequate but is rather abandoned in the face of its threat to survival. Moral obligation, rather than expanding to include the self, is rejected completely when the failure of response leaves the woman unwilling any longer to protect others at what is now seen to be her own expense. In the absence of morality, survival, however "selfish" or "immoral" returns as the paramount concern (p. 87).

For example, Sandra, a Catholic nurse, has strong moral feelings against abortion, but does it "because she has to" (p. 85). It is a choice between murdering the fetus or damaging herself and in the process hurt her parents. She agrees to the abortion and in her reasoning acknowledges that she is forced to change morally wrong to morally right. "Something is wrong, but all of a sudden, because you are doing it, it is right" (p. 86). In the discussion of Ellen (p. 87–89), the subject ends up rejecting her married boyfriend's idea that she should have the child and raise it herself without his support. She finally chooses abortion after acknowledging that it is the selfish alternative. She considers it a matter of survival, since it will allow her to continue her work as a musician, work which is essential to her self-concept. Ellen also struggles to find a method by which her self-interest can be justified in the face of a moral belief against abortion. She is able to argue for or against the morality of abortion "with a philosophical logic" but in the end chooses what she admits is a selfish alternative. Sarah is also forced to "reconstruct the dilemma in a way that yields a new priority which allows a decision" (p. 91). She rejects self-sacrifice and self-abnegation as "immoral in their power to hurt." She claims that the factors against abortion are the admiration she would receive as a single mother (presumably an illusory belief) and not having to face up to the guilt involved and balances this with the bad effects on her relationship with the father and her parents. In the end she decides to opt for the abortion which she acknowledges is in her self-interest and justifies it with a new self-image which emphasizes her honesty, aggressiveness, and directness. With an expanded self-concept that includes room for the primacy of self-interest she is now able to think of herself as a good person. Ruth, in deciding between pregnancy and an advanced degree, chooses career. She decides that the "selfish" thing is to discontinue the pregnancy, while pleasing others would mean having the baby. Gilligan describes this representation as self-deception, as Ruth's rationalization then moves to describing herself as "incredibly passionate and sensitive" and worrying that if she becomes a professional she will lose these qualities. She realizes that having an abortion would mean acknowledging she is ambitious. Martha also engages in self-deception. She realistically realizes having a baby will cut into her time and entail a lot of responsibility and she rejects her previous idea that having a baby would make her feel

happy as “selfish.” By counterfactually suggesting that having the baby would make her happy and then engaging in self-deception by providing a negative label such as “selfish” to this false idea, she is free to choose what in fact is the self-interested course.

Gilligan rightly criticizes the hypothetical moral dilemma approach to studying moral reasoning:

Hypothetical dilemmas, in the abstraction of their presentation, divest moral actors from the history and psychology of their individual lives and separate the moral problem from the social contingencies of its possible occurrence. In doing so, these dilemmas are useful for the distillation and refinement of objective principles of justice and for measuring the formal logic of equality and reciprocity. However, the reconstruction of the dilemma in its contextual particularity allows the understanding of cause and consequence which engages the compassion and tolerance repeatedly noted to distinguish the moral judgments of women (p. 100).

Women are said to construct hypothetical dilemmas in terms of the real and the particular. Independent of whether women are indeed more compassionate and tolerant than men, Gilligan is surely correct to insist on the contextual nature of moral choice.

The data of Gilligan, then, illustrate several aspects of a sociobiological approach to moral reasoning:

1. They deal with very real dilemmas in which there is a very clear cost to the person making the decision. The hypothetical dilemmas of Kohlberg allow individuals to reason about morality apart from having to actually make a decision that vitally affects their lives. An evolutionary theory must suppose that it is in situations of high potential cost that the most salient aspects of moral reasoning will be exhibited.

2. The data clearly show that the ultimate dilemma is between self-interest versus the demands of moral principles and the demands of other individuals. Significantly, the women discussed by Gilligan all chose the behavior that they deemed to be self-interested. The decision of abortion takes place in a complex cultural nexus, but clearly the most common reasons for choosing abortion in these data had to do with lack of economic and emotional support from the father and constrictions placed upon the woman's life and career that pregnancy and childbirth would entail. Since the study does not include a random sample of pregnant women with motives for abortion, it is unknown whether in fact all such women would be similarly self-interested. Perhaps the women who are self-sacrificing and morally principled simply avoid abortion and pregnancy counseling services, the source of Gilligan's subjects. Finally, although Gilligan describes this material as illustrating an ethic of care and responsibility, it is also an ethic in which these terms have been redefined to include centrally care and responsibility for oneself. From

a sociobiological point of view the emphasis on self-interest in the final decision is not at all surprising.

3. Gilligan emphasizes the contextual nature of these decisions. Although moral principles are not unimportant in producing guilt and the need for self-justification and rationalization, the claims of other individuals, especially individuals to whom the subject has affective ties, assume great importance. Here parents, boyfriends, and husbands are an important part of the decision-making process. From a sociobiological perspective this is not surprising, and such considerations undoubtedly play an important role in the decisions of men as well as women. Indeed, the results of Gilligan do not indicate that in matters of great ecological importance men differ at all from women in the importance of contextual factors. The reasoning of the women confronting this major problem in their lives is compared to the reasoning of men on the hypothetical moral dilemmas of Kohlberg. Gilligan's conclusion would be far more convincing if it were based on the reasoning of men in similar situations. As indicated above, the conclusion of many studies comparing males and females on moral reasoning indicates very little, if any, difference between the sexes (Kohlberg, 1984; Rest, 1983).

This is not to state that there may not indeed be such differences as proposed by Gilligan. From a sociobiological perspective considerations of the effects of one's actions on relatives and those with whom one has formed affective bonds are expected to be quite important for both sexes, although it is possible that the sexes diverge in the relative importance of these factors (MacDonald, 1987a). Affective relationships involve biological systems which affect moral and prosocial actions (MacDonald, 1984). These systems are viewed as having evolved to create the bonds which hold families together. Decisions which affect oneself and/or family members are expected to be made according to a different calculus than decisions which affect only strangers, another reason why the real-life moral dilemma of abortion is far more interesting from a sociobiological perspective than are the hypothetical dilemmas of Kohlberg and Piaget. Nevertheless, these affective ties can be overcome when the agent perceives that acting in conformity with them is against her self-interest. Ellen at one point believes that the plan of her married boyfriend to have her raise the child without his support or presence is "better thought out and more logical and correct" but in the end she chooses abortion despite her feelings for the man.

4. The study also illustrates well the active framing process used in moral reasoning, including the existence of self-deception. Changing an action from being selfish to being the result of honesty, ambition, or aggressiveness makes it much more acceptable. Sometimes the women would seem to create a "straw man" argument supporting the pregnancy and then destroy the argument and thus reassert their self-interest.

Since Gilligan wants to see her subjects in a sympathetic light, she casts their reasoning into an ethic of care and responsibility. In any event, the dynamics of rationalization and self-deception are a very promising area for sociobiological inquiry. If examples such as those of Gilligan can be found to be a general phenomenon, moral reasoning would emerge as a process whereby one's self-interest is chosen according to reasons which make the actor feel good about himself/herself. As Wilson (1978) states, individuals tend to believe what is in their self-interest.

As another possible example from the research literature in which self-deception occurs, Ugurel-Semin (1952) described some selfish children (a minority of the entire sample) as inverting rules in order to justify selfish behavior and as inventing moral principles to justify their conduct.

It is appropriate to include in this section studies which indicate that individuals engage in a variety of defensive maneuvers in order to deny responsibility to act in morally relevant situations, maneuvers which can, in terms of Rest's model, result in a reappraisal of the moral nature of the situation (Rest, 1983) and presumably therefore affect the applicability of the moral reasoning process. Schwartz and Howard (1984) describe four types of defensive methods which reduce decisional conflict in situations where altruism is a possibility: Denial of need, denial of the effectiveness of actions, denial of personal ability, and denial of responsibility. Denial of need refers to a person "seeking cues that permit denial of the need or at least a reduction in its severity (e.g., "That's not an assault, it's a lover's quarrel," p. 236). Denial of effectiveness of action refers to reconceptualizing the situation by denying that the action would really help (e.g., "No point intervening, they'll just start up again as soon as I leave," (p. 236). Denial of personal ability refers to reconceptualizing the situation by denying one's competence to perform the contemplated action. Finally, denial of responsibility refers to reconceptualizing the situation by finding particular circumstances in the present case which render moral action unnecessary, such as illness, provocation, external pressure, etc. Other researchers have noted that exploiters rationalize exploitation by derogating the victim (Glass, 1964) and minimizing the victim's suffering (Brock & Buss, 1962).

Finally, mention should also be made here of work on excuse making. Snyder, Higgins, and Stucky (1983) summarize work showing how excuses function to justify behavior and result in positive self-image. Although not explicitly oriented toward moral issues, much of this work parallels quite closely the work described by Schwartz above and indicates quite clearly the many intricate means by which humans are capable of placing their behavior in a rosy perspective.

5. MORAL REASONING AS INTENTIONAL DECEPTION

Is there evidence that individuals deliberately attempt to deceive others regarding their moral reasoning? Although I know of no studies of this

issue, there is good anecdotal reason to suppose that in fact such behavior occurs. Rest (1979) notes that politicians may hire speechwriters to find ideas that appeal to voters and suggests that this was a characteristic of the Nixon administration. It is presumably also the case that criminals often hire lawyers partly in order to have their actions presented in the best possible light. "Regardless of one's stage . . . a person can fake great concern for moral values" (Rest, 1979).

6. IGNORING ONE'S OWN MORAL REASONING

Although the generality of this phenomenon is questionable, there are indeed cases where individuals reject the conclusions of their own moral reasoning and opt for self-interest. The case of Janet from Gilligan's (1982) report, described above, illustrates a case of ignoring one's own moral reasoning. The woman, a Catholic, has a conflict among moral principles and medical advice, financial self-interest, and her husband's affection. She chooses abortion for admittedly selfish reasons, but does not reject the general principle that abortion is morally wrong. She thus is able to say to herself that what she is doing is morally wrong but she will do it anyway. As another example, Ugurel-Semin (1952) found that among children who divided an odd number of nuts in a selfish manner there was a subgroup who expressed moral disapproval of their own behavior.

The possibility of ignoring one's own moral reasoning is implicit in Rest's (1983) four-component model of moral action: Component III, the decision of what one actually intends to do, can conflict with Component II, the morally ideal course of action. Indeed, moral reasoning is sometimes rejected in favor of more powerful demands, usually demands which coincide with self-interest. Thus Rest cites the case of John Dean, who stated in his book *Blind Ambition* that questions of morality and justice were overridden by more pressing concerns. The data discussed in the previous section showing gaps between real-life and hypothetical reasoning due to self-interest can also be interpreted as indicating that people may reject their own moral reasoning when it conflicts with their self-interest.

7. CROSS-CULTURAL DATA: THE PRIMACY OF SELF-INTEREST, RECIPROCITY, AND SOCIAL RELATIONSHIPS

As indicated above, Kohlberg has taken a strong cognitive-developmental position regarding the status of stages of moral development. One aspect of this strong stand has been the idea that the stages of moral reasoning are culturally universal, just as is claimed for the stages of purely cognitive development proposed by Piaget. Regarding the stages of purely cognitive development, there is indeed good evi-

dence that sensorimotor, preoperational, and concrete operational intelligence develop in all normal human environments (Dasen, 1982; MacDonald, 1986a; see also Scarr, 1976 for a similar argument applied only to sensorimotor intelligence). These stages may thus be considered to be well-buffered phenotypes in the sense of Waddington (1956) (MacDonald, 1985). For the stage of formal operations there is considerable evidence that its development only occurs under conditions of formal Western-type schooling.

A similar situation appears to occur in the case of moral reasoning. As in the case of purely cognitive development, there are suggestions that the earliest of Kohlberg's stages occur in all cultures, while the more advanced stages, those past stage 3, appear to require exposure to more formal education and perhaps participation in a centralized society rather than one based on kinship relations. Kohlberg (1984) reports data from village and urban settings in Turkey. The results show that the subjects tend to advance in level of moral judgment but that village residents do so more slowly than urban residents. Moreover, the village residents seem to stabilize at stage 3. The urban residents tended to have higher stages than the rural residents but only 1 of 20 achieved a stage rating of at least 4. Edwards (1975) similarly found that her subjects stabilized at stage 3 and suggested that this stage was necessary and sufficient in societies based on face-to-face relationships and a high level of normative consensus. Recently Tietjen and Walker (1985) found in a sample of New Guinea males that stage 3 was the highest modal stage attained and that no individual consistently reasoned at a stage 4 level.

These results fit well with a sociobiological viewpoint. Stage 3 moral judgments are made at the level of particular relationships. In societies without centralized political control, familial and kinship relations predominate (MacDonald, 1984; 1987b). Self-interest, reciprocity, as well as the affective relations built up with particular individuals are expected to be of great importance and weigh heavily in moral decision making. Just as the subjects in Gilligan's study were heavily influenced by the context of the moral decision and especially with affectively tinged relationships and were unconcerned about the society as a whole or about the rights of individuals existing prior to society, the subjects of the studies discussed here are able to look no further than their own particular relationships in finding a rationale for their behavior. An individual in a contemporary industrial society easily sees himself/herself as embedded in this larger context and can resort to stage 4 and 5 reasoning to rationalize his/her behavior. Indeed, Kohlberg (1984) attributes the more advanced moral reasoning skills of middle-class children compared to lower-class children as due to their being able to see themselves as embedded in a larger institutional framework required for stage 4 and 5 reasoning. These results are consistent with

a large gap between moral reasoning and moral behavior, as previously argued: Unless one is prepared to argue that people in more advanced societies generally behave in a more moral manner, it is reasonable to suppose that what changes in the shift to more advanced, centralized societies is the style of reasoning, not the morality of actual behavior. Reasons appealing to the need for laws and social order, as well as appeals to human rights that transcend laws, become a possibility in these more advanced societies, and because of their appeal to disinterested individuals, become important tools in justifying self-interested behavior.

In terms of human evolution, then, it is unlikely that stage 4 or stage 5 reasoning would occur in family- and kinship-based societies. If sociobiological theory is correct, when moral reasoning actually occurs in these societies it should be powerfully influenced by the particular relationships of the individuals involved, especially relationships of kinship and affectively tinged relationships.

Finally, it should be pointed out that the patterns of altruistic behavior observed cross-culturally correspond well with sociobiological theory. Alexander (1979) has summarized anthropological literature which indicates that as behavior is directed toward more distantly related individuals there is a decrease in altruism. Within the family high levels of altruism are observed, and people are often willing to sustain large debts and give more than they receive. Within the wider social unit reciprocity is the norm, and with individuals even further removed from the social group, such as strangers or foreigners, attempts at exploitation are common.

In the cross-cultural data, then, the degree of genetic relatedness and the costs and benefits of behavior are far better guides to behavior than universal stages of moral reasoning. These results are amplified by a recent study by Tietjen (1986) on prosocial reasoning among the Maisin of New Guinea. The lowest percentage of helping responses occurred in two stories, one involving a conflict between helping and delaying the protagonist's studies, while the other involved a conflict involving whether villagers who have only enough for their own needs should help a needy neighboring village whose fields have been flooded. In the former story, self-interest enters in because the principal means for obtaining money among the Maisin is from the remittances of their people who work away from home, and many Maisin noted that the protagonist should not help individuals not related to her when this would delay the ability of the individual to help her own relatives. In the second example, the conflict between the needs of one's own village and relatives versus a group of nonrelatives is resolved in favor of one's own village. The other two stories used in the study did not involve hypothetical situations in which self-interest was a factor.

A Note on the Role of Emotion in Moral and Prosocial Behavior

Recent treatments of prosocial behavior have emphasized the motivating role of emotions such as empathy and sympathy in morality and prosocial behavior (see especially Hoffman, 1982). The focus of this essay has been on the cognitive-developmental tradition which has focused almost exclusively on cognitive processes involved in morality. Indeed, Rest (1983) argues that emotions can never be a complete account of morality because, among other reasons, acting in accord with one's emotions can sometimes be immoral, as when one favors an individual to whom one has formed an attachment.

While it is true that emotions such as empathy can easily be overemphasized in an account of moral or prosocial behavior, there is every reason to believe that emotions are involved in motivating much real-life morally relevant behavior. In terms of the present essay, emotions can be seen as an important aspect of the context of real-life moral judgment and behavior. Thus, one of the reasons why there is such a significant gap between moral reasoning and moral behavior is that emotions are aroused in real-life situations where high costs and benefits are involved, whereas the standard hypothetical Kohlbergian dilemmas are designed to minimize emotional involvement. In the classic Heinz dilemma, the protagonist is from far-off Europe and has a foreign-sounding name, aspects which undoubtedly minimize emotional involvement for the subject. We have already seen that when the protagonists are family members or friends there is an increase in hedonistic reasoning, a result that is reasonably believed to be at least partly due to the emotional involvement occurring in such a relationship. The rather tortured reasoning occurring in many of Gilligan's subjects also appears to be due in part to emotional conflicts which occur as a result of relationships to boyfriends, husbands, and parents.

From a sociobiological viewpoint this strong contextual effect of emotions makes a great deal of sense. The strongest emotional reactions occur among family members and are expected to skew moral reasoning and moral behavior in the direction of favoring the interests of such individuals. Affectively warm parent-child interactions have been shown to be associated with a generalized increase in altruism and prosocial behavior (e.g., Clary & Miller, 1986; Rosenhan, 1970). This may be due to an effect of the positive affective relationship with an individual on increasing emotions such as sympathy for the individual. If, indeed, warm familial affective relationships then generalize to other individuals as many theorists believe (e.g., Ainsworth, Blehar, Waters, & Wall, 1978; Pastor, 1981; Staub, 1978, 1979, 1986; Waters, Wippman, & Sroufe, 1979), it is quite possible that one develops a fairly generalized sympathy to other individuals which mediates a higher level of altru-

istic behavior towards them. In some cases this generalized sympathy may lead to individuals being willing to incur negative cost-benefit relationships with others, at least over the short term. Thus Youniss (1986) notes that friendship among children is affectively based as well as characterized by reciprocity. However, "(C)lose friends in an enduring relationship do not have to reciprocate either immediately or on identical terms." Finally, behavioral ethologists (e.g., Lorenz, 1966) have suggested that there are stimuli which affect innate tendencies for helping behaviors, such as a childlike appearance. Presumably these innate tendencies work by eliciting empathic and sympathetic emotions.

Conclusion

The foregoing indicates strong support for the propositions derived from sociobiological theory. It is important, however, to place these findings in perspective. Whatever the tendencies for humans to be selfish, social controls on human behavior are possible and indeed have demonstrated importance in human societies (Alexander, 1979). Although social controls in human societies have often favored the wealthy and the powerful, there are many examples of egalitarian controls on individual behavior (MacDonald, 1983, 1984, 1987b). For example, individuals in our society are required to pay taxes which are used in part to aid the poor and the elderly. Even if one has very selfish tendencies and would never voluntarily help such people, most people pay their taxes and people who don't are subject to prosecution. By constructing elaborate systems of social control (and probably only by these means) modern societies are able to ensure relatively high levels of prosocial behavior within a society by essentially engineering reinforcement contingencies. Egalitarian social controls on sexual behavior have been a prominent feature of Western societies for at least 1000 years and have recently become a feature of such traditionally sexually competitive societies as China (MacDonald, 1983; see also this vol., Chap. 11).

Within psychology, there has been a long tradition which essentially views socialization as the placing of social controls on individual behavior. Within the Freudian tradition individuals are seen as subject to strong instinctual tendencies of a selfish and aggressive nature and it is the role of society and especially the family to overcome these tendencies and instill a strong superego to combat these tendencies (see MacDonald, 1986b, for a discussion of the Freudian viewpoint on these matters from a sociobiological perspective).

Within the American psychological mainstream, the behaviorist tradition, including modern social learning theory, has viewed self-interest as fundamental to understanding human behavior. Such a viewpoint is quite compatible with sociobiological theory and, indeed, it is only by

invoking an ultimate level theory such as sociobiology that this state of affairs makes sense. Research within this tradition has also emphasized potential environmental social controls which foster morality and altruism. Many of the controls advocated within this tradition take advantage of modeling and other forms of learning, the capacity for which must be biologically based (Pulliam & Dunford, 1980). Thus for example, many social learning theorists have advocated modeling, reinforcement, and instruction of prosocial and morally desired behaviors on television, in the schools, and within the family in order to alter the baseline levels of these behaviors found within a particular society. A vast research literature indicates that indeed these techniques can have some effect (see, for example, Rushton, 1980, and Staub, 1978, 1979, for reviews). Self-interest appears, however, to be a very resilient and robust tendency in humans and is unlikely to be eradicated, if indeed it should be, by these methods alone. The necessity of including a cost-benefit analysis as essential to a model of prosocial behavior and altruism is now recognized by a number of theorists within mainstream developmental research (see, e.g., Eisenberg, 1986; Gelfand & Hartman, 1982; Piliavin, Dovidio, Gaertner & Clark, 1981; Widaman & Little, 1985).

Besides the role of social controls on human behavior, there is ample evidence that socialization methods within the family can increase general dispositions toward prosocial behavior and altruism. Research has focused on methods of parental reasoning about prosocial behavior with their children (Hoffman, 1970) and the role of affectively warm parent-child relationships and the modeling of altruistic behavior (Clary & Miller, 1986; Rosenhan, 1970; Staub, 1978). An approach which has attempted to bridge the gap between evolutionary and psychological aspects of altruism, and by extension, moral behavior, has been to emphasize the role of familial affective relationships and the modeling of prosocial behavior in the socialization of altruism (MacDonald, 1984, 1987b). This approach relies on an ethological view of familial affective relationships and social learning theory (see this vol., Chap. 11), and is consistent with much of the psychological theory and research on altruism (see especially Rosenhan, 1970, and Clary & Miller, 1986). Such an approach has the advantage of tying in well with the cross-cultural literature on the socialization of altruism, so that it provides a theory of the behavioral ecology of prosocial behavior and morality in human evolution. From this point of view, although self-interest is central to human behavior, the altruistic, prosocial relationships necessary for adaptive family functioning are an important biological adaptation, and although originally directed toward close relatives, the mechanism works equally well with the nonrelatives that we are now surrounded with. Nevertheless, it is undoubtedly impossible to imagine a complex society that does not back up effective socialization methods with social controls of a legal nature in its attempt to

ensure that certain types of exploitation are unrewarded and that public programs foster prosocial and moral actions toward individuals unable to support themselves.

Finally, the foregoing should not be interpreted as indicating that the cognitive-developmental program in moral development is without a great deal of substantive merit as a view of how children's thinking about moral questions develops. Although it is apparently possible to teach many older children to reason at a stage 5 level, this is presumably not possible with a 6-year-old, and this is an important developmental fact. Trying to understand when and how children are able to grasp progressively more difficult and abstract cognitive material is the essence of the field of cognitive-developmental psychology, and the development of moral reasoning will inevitably reflect this.

REFERENCES

- Ainsworth, M.D., Blehar, M.C., Waters, E., & Wall, S. (1978). *Patterns of attachment*. Hillsdale, NJ: Erlbaum.
- Alexander, R. (1979). *Darwinism and human affairs*. Seattle: University of Washington Press.
- Bar-Tal, D., Raviv, A., & Leiser, T. (1980). The development of altruistic behavior: Empirical evidence. *Developmental Psychology*, 16, 516-524.
- Blasi, A. (1980). Bridging moral cognition and moral action: A critical review. *Psychological Bulletin*, 88, 1-45.
- Blasi, A. (1983). Bridging moral cognition and action: A theoretical view. *Developmental Review*, 3, 178-210.
- Brock, T.C., & Buss, A.H. (1962). Dissonance, aggression and the evaluation of pain. *Journal of Abnormal and Social Psychology*, 65, 197-202.
- Bryan, J.H., & Walbek, N.H. (1970). Preaching and practicing generosity: Children's actions and reactions. *Child Development*, 41, 329-354.
- Campbell, D.T. (1965). Ethnocentric and other altruistic motives. In D. Levine (Ed.), *Nebraska symposium on motivation*. Lincoln: University of Nebraska Press.
- Clary, E.G., & Miller, J. (1986). Socialization and situational influences on sustained altruism. *Child Development*, 57, 1358-1369.
- Damon, W. (1977). *The social world of the child*. San Francisco: Jossey-Bass, Inc.
- Dasen, P. (1982). Piagetian psychology: Cross-cultural contributions. In H. Triandis (Ed.), *Handbook of cross-cultural psychology* (Vol. 4). Boston: Allyn and Bacon.
- Edwards, C.P. (1975). Societal complexity and moral development. *Ethos*, 3, 505-527.
- Eisenberg, N. (1986). *Altruistic emotion, cognition and behavior*. Hillsdale, NJ: Erlbaum.
- Eisenberg-Berg, N., & Gershaker, E. (1979). Content of preachings and power of the model/preacher: The effects on children's generosity. *Developmental Psychology*, 15, 168-175.

- Eisenberg-Berg, N., & Neal, C. (1981). Children's moral reasoning about self and others: Effects of identity of the story character and cost of helping. *Personality and Social Psychology Bulletin*, 7, 17-23.
- Fischer, W.F. (1963). Sharing in pre-school children as a function of amount and type of reinforcement. *Genetic Psychology Monographs*, 68, 215-245.
- Gelfand, D., & Hartmann, D.P. (1982). Response consequences and attributions: Two contributors to prosocial behavior. In N. Eisenberg (Ed.), *The development of prosocial behavior*. New York: Academic Press.
- Gilligan, C. (1977). In a different voice: Women's conception of the self and of morality. *Harvard Educational Review*, 47, 481-517.
- Gilligan, C. (1982). *In a different voice: Psychological theory and women's development*. Cambridge: Harvard University Press.
- Glass, D.C. (1964). Changes in liking as a means of reducing cognitive discrepancies between self-esteem and aggression. *Journal of Personality*, 32, 531-549.
- Grusec, J.E., Saas-Kortsak, P., & Simutis, Z.M. (1978). The role of example and moral exhortation in the training of altruism. *Child Development*, 49, 920-923.
- Haan, N. (1977). *Coping and Defending: Processes of self-environment organization*. New York: Academic Press.
- Haan, N. (1978). Two moralities in action contexts: Relationships to thought, ego regulation and development. *Journal of Personality and Social Psychology*, 36, 286-305.
- Helkama, K. (1979). *The development of the attribution of responsibility: A critical survey of empirical research and a theoretical outline* (Vol. 3). University of Helsinki: Research Reports of the Department of Social Psychology.
- Hoffman, M. (1970). Moral development. In P. Mussen (Ed.), *Carmichael's manual of child development*. New York: Wiley.
- Hoffman, M. (1982). Development of prosocial motivation: Empathy and guilt. In N. Eisenberg (Ed.) *The development of prosocial behavior*. New York: Academic Press.
- Kohlberg, L. (1984). *Essays on moral development: Vol. 2, The psychology of moral development*. San Francisco: Harper & Row.
- Kohlberg, L., & Candee, D. (1984). The relationship of moral judgment to moral behavior. In L. Kohlberg (Ed.), *Essays on moral development: Vol. 2, The psychology of moral development*. San Francisco: Harper & Row.
- Krebs, D., Schroeder, M., & Denton, K. (1987, January). On the corruption of pure reason in the moral domain. Paper presented at the symposium *From moral judgment to moral action and back again*. Harvard University, Cambridge, MA.
- Leming, J. (1978). Interpersonal variations in stage of moral reasoning among adolescents as a function of situational context. *Journal of Youth and Adolescence*, 7, 405-416.
- Levine, C. (1976). Role-taking standpoint and adolescent usage of Kohlberg's conventional stages of moral reasoning. *Journal of Personality and Social Psychology*, 34, 41-47.
- Lorenz, K. (1966). *On aggression*. New York: Harcourt, Brace & World.
- MacDonald, K.B. (1983). Production, social controls and ideology: Toward a sociobiology of the phenotype. *Journal of Social and Biological Structures*, 6, 297-317.

- MacDonald, K.B. (1984). An ethological-social learning theory of the development of altruism: Implications for human sociobiology. *Ethology and Sociobiology*, 5, 97-109.
- MacDonald, K.B. (1985). Early experience, relative plasticity and social development. *Developmental Review*, 5, 99-121.
- MacDonald, K.B. (1986a). Early experience, relative plasticity, and cognitive development. *Journal of Applied Developmental Psychology*.
- MacDonald, K.B. (1986b). *Civilization and its discontents* revisited: Freud as an evolutionary biologist. *Journal of Social and Biological Structures*, 9, 213-220.
- MacDonald, K.B. (1987a). [Review of L. Rosenblum & H. Moltz (Eds.), *Symbiosis in parent-offspring interactions*. *Developmental Psychobiology*, 20, 477-484.
- MacDonald, K.B. (1987b). Biological and psychosocial interactions in early adolescence: A sociobiological perspective. In R.M. Lerner & T.T. Foch (Eds.), *Biological and psychosocial interactions in early adolescence: A lifespan perspective*. Hillsdale, NJ: Erlbaum.
- McNamee, S. (1978). Moral behavior, moral development and motivation. *Journal of Moral Education*, 7, 27-31.
- Pastor, D.L. (1981). The quality of mother-infant attachment and its relationship to toddler's sociability to peers. *Developmental Psychology*, 17, 326-335.
- Piliavin, J.A., Dovidio, J.F., Gaertner, S.L., & Clark, R.D. (1981). *Emergency intervention*. New York: Academic Press.
- Pulliam, H.R. & Dunford, C. (1980). *Programmed to learn*. New York: Columbia University Press.
- Rest, J.R. (1979). *Development in judging moral issues*. Minneapolis: University of Minnesota Press.
- Rest, J.R. (1983). Morality. In J.H. Flavell & E. Markman (Eds.), *Manual of Child Psychology* (4th ed.): Vol. 3, *Cognitive development*. New York: John Wiley.
- Rest, J.R., & Thoma, S.J. (1985). Relation of moral judgment development to formal education. *Developmental Psychology*, 21, 709-714.
- Rholes, W.S., & Bailey, S. (1983). The effects of moral reasoning on consistency between moral attitudes and related behaviors. *Social Cognition*, 2, 32-48.
- Rholes, W.S., & Lane, J.W. (1985). Consistency between cognitions and behavior: Cause and consequence of cognitive moral development. In J.B. Pryor & J.D. Day (Eds.), *The development of social cognition*. New York: Springer-Verlag.
- Rice, M., & Grusec, J. (1975). Saying and doing: Effects on observer performance. *Journal of Personality and Social Psychology*, 32, 584-593.
- Rosenhan, D. (1970). The natural socialization of altruistic autonomy. In J. Macauley & L. Berkowitz (Ed.), *Altruism and helping behavior*. New York: Academic Press.
- Rushton, J.P. (1980). *Altruism, socialization and society*. Englewood Cliffs, NJ: Prentice-Hall.
- Rushton, J.P. (1982). Social learning theory and the development of prosocial behavior. In N. Eisenberg (Ed.), *The development of prosocial behavior*. New York: Academic Press.
- Rushton, J.P., & Littlefield, C. (1979). The effects of age, amount of modeling, and a success experience on seven- to eleven-year-old children's generosity. *Journal of Moral Education*, 9, 55-56.

- Rushton, J.P., & Teachman, G. (1978). The effects of positive reinforcement, attributions, and punishment on model induced altruism in children. *Personality and Social Psychology Bulletin*, 4, 322-325.
- Scarr, S. (1976). An evolutionary perspective on infant intelligence: Species patterns and individual variations. In M. Lewis (Ed.), *The origins of infant intelligence*. New York: Plenum Press.
- Schwartz, S.H., & Howard, J.A. (1984). Internalized values as motivators of altruism. In E. Staub, D. Bar-Tal, J. Karylowski, & J. Reykowski (Eds.), *Development and maintenance of prosocial behavior*. New York: Plenum Press.
- Snyder, C.R., Higgins, R.L., & Stucky, R.J. (1983). *Excuses: Masquerades in search of grace*. New York: John Wiley.
- Sobesky, W.E. (1983). The effects of situational factors on moral judgments. *Child Development*, 54, 575-584.
- Staub, E. (1978). *Positive prosocial behavior and morality* (Vol. 1). New York: Academic Press.
- Staub, E. (1979). *Positive prosocial behavior and morality* (Vol. 2). New York: Academic Press.
- Staub, E. (1986). A conception of the determinants and development of altruism and aggression: Motives, the self, and the environment. In C. Zahn-Waxler, E.M. Cummings, & R. Iannotti (Eds.), *Altruism and aggression*. New York: Cambridge University Press.
- Tietjen, A.M. (1986). Prosocial reasoning among children and adults in a Papua New Guinea society. *Developmental Psychology*, 22, 861-868.
- Tietjen, A., & Walker, L. (1985). Moral reasoning and leadership among men in a Papua New Guinea society. *Developmental Psychology*, 21, 982-992.
- Ugurel-Semin, R. (1952). Moral behavior and moral judgment of children. *Journal of Abnormal and Social Psychology*, 47, 463-474.
- Waddington, C.H. (1957). *The strategy of the genes*. London: Allen and Son.
- Waters, E., Wippman J., & Sroufe, L.A. (1979). Attachment, positive affect and competence in the peer group: Two studies in construct validation. *Child Development*, 50, 821-829.
- White, G.M. (1972). Immediate and deferred effects of model observation and guided and unguided rehearsal of donation and stealing. *Journal of Personality and Social Psychology*, 21, 139-148.
- White, G.M., & Burnham, M.A. (1975). Socially cued altruism: Effects of modeling, instructions, and age on public and private donations. *Child Development*, 46, 559-563.
- Widaman, K.F., & Little, T.D. (1985). Contextual influences on sociomoral judgment and action. In J.B. Pryor & J.D. Day (Eds.), *The development of social cognition*. New York: Springer-Verlag.
- Wilson, E.O. (1975). *Sociobiology: The new synthesis*. Cambridge: Harvard University Press.
- Wilson, E.O. (1978). *On human nature*. Cambridge: Harvard University Press.
- Worchel, S. (1984). The darker side of helping behavior: The social dynamics of helping and cooperation. In E. Staub, D. Bar-Tel, J. Karylowski, & J. Reykowski (Eds.), *Development and maintenance of prosocial behavior*. New York: Plenum.

- Youniss, J. (1986). Development in reciprocity through friendship. In C. Zahn-Waxler, E.M. Cummings, and R Iannotti (Eds.), *Altruism and Aggression: Biological and social origins*. New York: Cambridge University Press.
- Zahn-Waxler, C., & Radke-Yarrow, M. (1982). The development of altruism: Alternative research strategies. In N. Eisenberg (Ed.), *The development of prosocial behavior*. New York: Academic Press.

6

Cooperation, Competition, and Altruism in Human Twinships: A Sociobiological Approach

NANCY L. SEGAL

My boys were thrilled to learn that they are definitely identical twins. Why, I don't really know, but it is a big deal to them.—Mother of twins

They [two identical triplet brothers] are more important to each other than I am to either of them.—Fraternal triplet

Introduction

The comparative study of social relationships within monozygotic (MZ) and dizygotic (DZ) twin pairs affords a novel and informative approach to understanding how relative genetic relatedness may affect social-interactional outcomes and processes. Some old questions, such as whether MZ twins are more cooperative than DZ twins, acquire fresh meaning in light of social-genetic and sociobiological theorizing. Consider, for example, the two quotations cited above: These statements are generally reflective of the social-interactional tendencies observed between identical and fraternal twins (Frank & Cohen, 1980; Koch, 1966). Psychoanalytically oriented psychologists would most likely offer explanations based on parental attitude, physical similarity, and cultural expectations: "Physical similarity, mutual satisfactions, and reactions of others induce [identical] twins to see themselves as intimately connected and undifferentiated parts of [an] inseparable unit" (Siemon, 1980). A sociobiological view additionally acknowledges the relative genetic commonality in the two types of twins as contributing to their average differences in affiliation. It might be argued that the genetic identity of MZ twins may underlie hypothesized "recognition mechanisms" that could "trigger a series of emotions whose net effect is tribal unity" (Freedman, 1979). These two interpretations are completely compatible. The latter view, however (which draws upon human and nonhuman evolutionary history), holds powerful implications for the development of cooperation and competition within families and, per-

haps, populations. The “why” of social relationships can be addressed in the broadest context possible.

Novel methodologies have evolved to accommodate the growing number of sociobiologically based inquiries. Behavioral geneticists, for example, typically compare MZ and DZ co-twins with respect to resemblance in behavioral characteristics. Greater resemblance within MZ twinships, relative to DZ twinships, is consistent with (although not proof of) a genetic influence on the behavior or trait of interest. Individuals interested in developmental issues might apply this research strategy longitudinally to determine the relative contributions of nature and nurture to behavioral and physical change across the lifespan. (Twin methodology is discussed in greater detail below.) The introduction of social-genetic and kinship-genetic perspectives, however, shifts attention away from twins as individual pair members to *interactive participants in a variety of social contexts*. The new item of analysis, therefore, becomes the *social group*. Critical implications and interpretations of human social behavior, at multiple levels of analysis, can result from such efforts.

In recent years, the behavioral sciences have witnessed a substantial increase in the number of interdisciplinary studies. Such efforts surely broaden the scope of both the research questions and significance of the findings. Scholarly contributions by Pepitone (1976), Fuller (1983a, 1983b), Scott (1977, 1983), Vine (1983), MacDonald (1984), Freedman (1986), and Zahn-Waxler, Cummings, & Iannotti (1986) are excellent examples of how researchers representing specialized disciplines can gain immeasurably by exposure to new concepts and methods. The use of twin studies to elucidate the biological and social influences on altruism is, in fact, cited as a new direction for developmental research in this area (Zahn-Waxler, 1986).

The general goal of this chapter is to demonstrate the usefulness and importance of appraising human developmental data from a sociobiological perspective. The primary specific goal is to show how twins may be used for evaluating principles and predictions generated by sociobiology. An attempt is made to show that some commonly displayed yet very fundamental and complex aspects of human behavior may gain comprehensibility by combining the tools of the developmentalist and the sociobiologist. Material relevant to these goals is drawn from several sources: (1) studies of social relationships in twin pairs, (2) studies and documents concerning the impact of twin loss to surviving co-twins, (3) case histories from previous studies of twins reared apart, and life history information gathered from participants in the ongoing Minnesota Study of Twins Reared Apart, and (4) interviews addressing the significance of twinship among MZ and DZ twins who survived the holocaust.

Twin Studies: A Brief Overview

TWIN TYPES

Monozygotic (MZ, or identical) twins result from the splitting of a single fertilized egg within 1–14 days postconception. MZ twins share all of their genes in common so that any differences between them must be environmental in origin. MZ twins are, with rare exception (Vandenberg, 1966; Dallapiccola, Stomeo, Ferranti, DiLecce, & Purpura, 1985), always of the same sex. Dizygotic (DZ, or fraternal) twins form from the separate fertilizations of two separate eggs by two separate sperm. These events yield two individuals who share half their genes in common, on average, by descent. The genetic relationship between DZ co-twins is, therefore, the same as that of nontwin siblings. Differences between DZ twins may be genetic and/or environmental in origin. DZ twins may be either of the same or opposite sex. MZ twins comprise approximately one-third of twins among Caucasian populations, while DZ twins comprise approximately two-thirds, being equally divided between same-sex and opposite-sex twin pairs. More detailed information on the biology of twinning is found in Bulmer (1970), Bryan (1983), and the journal *Twin Research*.

MZ twinning appears to be a randomly occurring process, although recent evidence suggests that a genetic component may be operative within some families (Carter-Saltzman, 1979; Levy, 1981; Parisi, Gatti, Prinzi, & Caperna, 1983). DZ twinning, in contrast, appears to be in part genetically mediated, although the mode of transmission has not yet been identified. It is also known that the DZ twinning rate varies as a function of ethnicity, maternal age, maternal height and weight, and other factors (Corney et al., 1981; Elwood, 1985; Nylander, 1975; Wyshak, Honeyman, Flannery, & Beck, 1983). Recent studies have shown that the DZ twinning rate appears to be declining, while the MZ twinning rate appears constant (Hémon, Berger, & Lazar, 1981; Mosteller, Townsend, Corey, & Nance, 1981).

THE TWIN METHOD

The promise and potential of the twin method for examining genetic and environmental influences on behavior were enthusiastically endorsed by Sir Francis Galton (1875), in England, in a seminal paper, "The history of twins as a criterion of the relative powers of nature and nurture." The logic of the twin method is simple and elegant: Greater similarity between MZ twins than DZ twins suggests that the characteristic under study is influenced by genetic factors. The biological bases of twinning, while not fully understood in the late 1800s, led Galton to this view. The two types of twins were in fact not recognized

in psychological research until Merriman's (1924) study of intellectual resemblance.

The effective use of the twin method requires careful sampling of the two types of twins and accurate diagnoses of zygosity. Inaccurate estimates of genetic influences on behavior can result from recruitment bias (Lykken, McGue, & Tellegen, in press) and misclassification of twin pairs (Plomin, DeFries, & McClearn, 1980). Extensive blood-grouping analysis is currently regarded as the best objective method for establishing twin type, although physical resemblance questionnaires (Cohen, Dibble, Grave, & Pollin, 1973; Nichols & Bilbro, 1966) and dermatoglyphic analysis (Reed, Norton, & Christian, 1977) have been reliably employed. (See Segal, 1984b and Vogel & Motulsky, 1979 for a review of the comparative accuracy of the various diagnostic procedures).

Inherent in the reasoning underlying the twin method is the assumption of equal environments for MZ and DZ twins. This assumption has been a continuing source of contention on the part of some critics. It has been argued, for example, that more frequent provision of identical dress and activities for MZ twins, relative to DZ twins, are primarily responsible for their greater average similarity in behavior (Farber, 1981; Taylor, 1980). Such criticisms, however, are testable. Studies by Scarr and Carter-Saltzman (1979) and Loehlin and Nichols (1976) have shown that differential environmental treatment of MZ and DZ twins does *not* appear to be responsible for their relative resemblance. A recent study reports that MZ twins reared together and apart were equally similar on the 11 scales of the Minnesota Personality Questionnaire (Tellegen et al., in press). A number of useful variants of the classic twin design, such as co-twin control (Plomin & Willerman, 1975) and twin-family studies (Rose, Harris, Christian, & Nance, 1979) have appeared, some in an attempt to resolve such challenges. No single method is flawless, but the overall consistency of findings from psychological studies using twins, and studies using other pairs of relatives of varying degrees of genetic and environmental relatedness, justify twin designs for examining questions concerning genetic and environmental influences on human development. (See Bouchard, 1984, for an excellent discussion of social biases in twin research.) Twin methodology has, at present, been successfully incorporated into the research programs of a wide variety of behavioral and medical science disciplines.

Human Development and Sociobiology

THE GENETICS OF SOCIAL BEHAVIOR

Sociobiological analysis focuses on variation present across species. Genetic analysis of social behavior, in contrast, is chiefly concerned

with variation occurring within species. The majority of research on the genetics of social behavior has been done using nonhuman, inbred species, such as mice, rats, and dogs (Scott, 1977). This is because animal investigators have greater control over their research subjects with respect to arranging matings and other social interactions. Human investigators, in contrast, must capitalize upon naturally occurring life situations than can prove informative about social behavior.

The existence of MZ and DZ twins, in particular their relative genetic homogeneity, has encouraged creative efforts at the human level. Methodology developed for nonhuman work can, with some modification, be profitably applied in human research. The MZ Half-Sibling Model, derived from animal breeding experiments, has now been fruitfully utilized by investigators in this country and abroad. The children of MZ twins share the same genetic relationship as half-siblings, enabling a study of half-sibs in representative, intact families. Other informative relationships are provided by this family constellation, such as MZ twins reared together, and parents and offspring reared apart (Scarr-Salapatek, 1975). The "couple effect," or the diverse functional roles adopted by MZ co-twins (Zazzo, 1978) provides a human analog to interactions observed among members of a common inbred animal strain. Caution, however, urges that we not assume simple parallels in behavioral motivation or outcome (Hinde, 1983).

Scott (1983) reminds us that "the expression of social behavior is dependent not only on the interaction of genes within an individual but also on interaction with genes from another individual." He advocates the choice of dyadic relationships for experimental and theoretical purposes because of their simplicity, and because they possess the general features of a social system. If the specific goal of this chapter is to show how twins can be used to examine the tenets of sociobiological theory, then it is appropriate to begin this discussion by considering some key social-genetic principles and concepts.

In an excellent overview of issues in the genetic analysis of social behavior, Fuller and Hahn (1976) assert that genotypic effects upon joint behavior may be distinct from genotypic effects on individual behavior. This conclusion derives from animal research, but they acknowledge its likely application to all social organisms. This is a very important point because it suggests that behavioral variation displayed by individuals may be associated with their degree of genetic commonality. Two key hypotheses, based on Scott's (1977) work with dogs, further develop this theme: First, in situations requiring cooperation, pairs of dogs with similar genotypes perform more effectively than pairs of dogs with dissimilar genotypes. In competitive arenas, role differentiation is most likely between pairs of dogs with dissimilar genetic backgrounds. Second, early social exposure to partners with different genotypes is later conducive to cooperative encounters with partners of

either the same or different genotypes, relative to social experience restricted to partners with similar genotypes. Reasoning from these findings, Scott suggests some important implications for human behavior:

Translated into human terms, this would mean that identical twins should, on the average, be less well socially adjusted than fraternal twins; or, if one wishes to broaden the hypothesis, the greater variety of individuals with whom one has early experience, the better the chances of developing good cooperative relationships with a variety of individuals later in life (p. 338).

There seems to be a need to redirect attention to previously overlooked variables in the study of social processes. Strayer, Wareing, and Rushton (1979) and Strayer (1981) studied social constraints on altruistic displays among preschool children in a natural setting. They observed that altruistic tendencies were directed toward a limited number of peers, suggesting social specificity. Studies of naturally occurring altruism among young children have been reported (Yarrow & Waxler, 1976), but, as Strayer et al. (1979) suggest, many previous studies have not adequately considered social ecological factors in their analyses. The notion that genetic overlap may contribute to choice of friends and spouses, as well as to the nature and outcome of social interactions is an idea that is attracting attention by researchers (Rushton, Littlefield, & Lumsden, 1986; Russell, Rushton, & Wells, 1984).

Until recently, an adequate theoretical framework has generally been lacking for human studies of biological influences on social relations. It is, however, possible to find some early studies (albeit, only a few) that fit appropriately into a social-genetic context. An early German study (Von Bracken, 1934), using twins, is an excellent illustration of the social-genetic principles discussed above. Von Bracken's work, in fact, inspired the research on competition and cooperation reported in a later section. Young MZ and DZ twin pairs were observed during the completion of addition of one-digit numbers and substitution of letters according to a "code." Differences in work output between MZ twins diminished when working in the same room, as compared with working alone. Larger within-pair differences when working in isolation were associated with greater increases in work output or efficiency. This occurred because when the twins were together, the "stronger" twin allowed the "weaker" twin to catch up. In contrast, large differences between DZ twins when working alone were associated with slight increments or decrements in productivity when working together, while small intrapair differences following isolated work predicted large increases in productivity. In the first case, the within-pair DZ difference increased with the change in condition, while in the second case it decreased slightly. Von Bracken concluded that *MZ twins tend toward the preservation or restoration of harmony or equality, while DZ twins*

strive toward greater superiority, relative to the co-twin. This study is a striking example of Fuller and Hahn's assertion that the genotype may influence joint behavior differently than individual behavior. These results also speak strongly to the issue of social specificity described by Strayer and colleagues. The need to reappraise findings from existing studies, in light of social-genetic principles seems to be warranted.

KINSHIP—Genetic Principles of Behavior

Hamilton's (1964a, 1964b) theory of kin selection has stimulated many sociobiological analyses of human social behavior. The concepts and principles of his theory have been well described in his seminal papers. A brief review of his theory, especially as it relates to twin studies, is provided below.

The fundamental logical argument in Hamilton's theory of kin selection is that natural selection favors behavior that reduces the Darwinian fitness of organisms if this behavior enhances the fitness of organisms who are genetically related. A second key principle is that average gains in fitness to the recipient must exceed the average loss to the benefactor, multiplied by their coefficient of relationship, if there is to be selection for genes favoring the spread of altruism. Hamilton (1964a) explains how the parent-child relationship is illustrative of the above:

A gene causing its possessor to give parental care will leave more replica genes in the next generation than an allele having the opposite tendency. The selective advantage may be seen to lie through benefits conferred indifferently on a set of relatives each of which has a half chance of carrying the gene in question (p. 1).

Hamilton further describes the applicability of this model to social interactions occurring between other pairs of individuals who are differentially located along the spectrum of genetic relatedness. Degree of genetic commonality, by descent, is expressed by means of the coefficient of relationship. The coefficient of relationship (r) refers to the average proportion of genes shared by pairs of individuals. Parents and children always share one-half their genes in common ($r=.5$). Full siblings and DZ twins share half their genes in common, on average, by descent. The coefficient of relationship for such relatives is, therefore, .5, but in individual cases the proportion of shared genes may vary between 0 and 100%. (A value of $r=.00$ would indicate no genetic relationship, while a value of $r=1.0$ indicates complete genetic overlap, as in the case of MZ twins.) The calculations necessary to determine the degree of genetic relatedness between other pairs of relatives, such as cousins and half-siblings, are provided by Trivers (1985).

Hamilton (1964b) reminds us that:

Relationship alone never gives grounds for *certainty* that a person carries a gene which a relative is known to carry except when the relationship is "clonal" or "mitotic" (e.g., the two are monozygotic twins)—and even then, strictly, the possibility of an intervening mutation should be admitted. In general, it has been shown that Wright's Coefficient of Relationship r approximates closely to the chance that a replica will be carried (p. 18).

Comparative studies of twin relationships involving MZ and DZ twin pairs furnish an intriguing test of kinship-genetic principles. Reasoning from Hamilton's basic arguments, predictions of greater cooperation, affiliation, and altruism between MZ co-twins, relative to DZ co-twins, flow naturally. The complexity of the issues under study would, however, be obscured by failure to consider the *mechanisms* by which kin selection may affect social behavior. It is not the *fact* of shared genes that is critical for social bonding, but rather the *ways in which shared genes influence the brain to respond to objects and events in the environment*. A comprehensive review of the animal literature (Holmes & Sherman, 1983) suggests four mechanisms by which kin recognition may be accomplished: spatial distribution, association, phenotypic matching, and recognition alleles. (See Barash, 1982; Kurland, 1977; and Trivers, 1985 for other excellent reviews of this material.) Extensive observations of nonhuman primate populations suggest that complex cognitive mechanisms may underlie their social behavior (Cheney, Seyfarth, & Smuts, 1986). Cheney et al. further propose that some forms of intelligence (in both humans and nonhumans) may have evolved to meet the varied challenges posed by social interaction.

It is possible that, in humans, social bonding may be facilitated by neurological processes that underlie attraction between individuals who perceive similarities between themselves (Essock-Vitale & Fairbanks, 1979; Freedman, 1979). Trivers (1985) has argued that "selection will favor the ability to discriminate between intended recipients [of altruism] on the basis of degree of genetic relatedness (so that average r is relevant only under special circumstances)." In this regard, interviews with twins reared separately (following their reunion) are proving enormously informative.

In reviewing the different sets of evidence relevant to the social bonds between MZ and DZ twins, the principal organizing theme is the search for *consistencies*, rather than proofs. Such a spirit may be more likely to engage the reluctant newcomer to this field, and is completely consistent with the general and specific goals of this chapter outlined earlier.

TWIN RELATIONSHIPS: MZ AND DZ TWINS COMPARED

The special intimacy shared by members of MZ twin pairs has been convincingly demonstrated by a wide variety of experimental, clinical, observational, and anecdotal data. Their bond has been described as the

"closest known tie between two individuals" (Burlingham, 1952). The view that one *is* (Paluszny, Selzer, Vinokur, & Lewandowski, 1977) and *should be* closer to the twin than to other siblings has been expressed more frequently by MZ than by DZ twins (Mowrer, 1954). MZ twins also tend to remain in closer proximity to one another throughout their lifespan than DZ twins (Parker, 1964; Smith, Renshaw, & Renshaw, 1968). In a large study of high-school-age twins, Loehlin and Nichols (1976) reported that while there were no MZ-DZ differences in responses concerning fighting or satisfaction with the twinship, MZ pairs agreed more frequently as to the experiential aspects of their twin relationship. This is striking as it speaks to the more similar "powers of perception" and finely developed system of communication that may characterize individuals who possess a common heredity, relative to those who do not. A possible mechanism underlying differential social interaction within MZ and DZ twinships is therefore suggested.

The psychoanalytic literature reports that fantasies of having an identical twin are not infrequent (Burlingham, 1945). The common thread underlying these images is their identity to the individuals themselves (although the fantasized twin may complement the individual who endows them with qualities perceived to be lacking in him or herself). These fantasies often provide companionship and understanding unavailable from other sources.

MZ twins comprise the majority of participants in both twins clubs and scientific investigations, and so (on the basis of population statistics) are disproportionately represented. Overrepresentation of MZ twins in these activities suggests greater investment in twinship, relative to DZ twins. Individual exceptions, among both MZ and DZ pairs can, however, be expected. The behavior of women in a Mothers of Twins Club has also been described. Most striking to the researcher was the commitment of the members: "Such a group is almost a fulfillment of the old fantasy of having a twin who shares everything of importance" (Plank, 1958).

Convergence among numerous investigators with respect to the generally closer relationship between MZ co-twins than DZ co-twins, despite different instruments and twin populations, is impressive. There has, however, been less evidence of consensus as to the explanations for the apparently stronger MZ than DZ twin bond. In some studies of twin relationships (Ainslie, 1985), the unique biological and psychological circumstances associated with the various twinship categories have been unappreciated. Failure to organize twins according to zygosity can be extremely misleading (Segal, 1986a), and may partially explain the controversy surrounding the basis of twin group differences in social behavior. A reappraisal of twin relationships, with reference to social-genetic and kinship-genetic principles of behavior, is our next task.

Twin Relationships: A Sociobiological Approach

Most sociobiologists focus on cross-species variation to the near exclusion of within-species variation. Research in behavioral genetics and individual differences can, however, substantially enrich sociobiological investigations of human behavior. Rushton, Fulker, Neale, Nias, & Eysenck (1986) contrasted the genetic and environmental transmission of altruism and aggression in MZ and DZ twin pairs by means of paper and pencil questionnaires. Their data provide evidence of a substantial contribution of genetic factors to the behaviors in question, with a negligible effect from the twins' shared environment. It would seem, however, that differential tendencies toward cooperation and competition in MZ and DZ twinships could be highlighted even more dramatically *if co-twins engaged in joint activity*. A study of this design is described below.

COOPERATION, COMPETITION, AND ALTRUISM WITHIN MZ AND DZ TWIN PAIRS

A study comparing cooperation, competition, and altruism within MZ and DZ twinships was conducted at the University of Chicago, using 105 pairs of twins (70 MZ pairs and 35 DZ pairs; mean age=8.03 years, s.d.=1.51). Information concerning subject selection, zygosity determination, research design, and data analysis is provided in Segal (1984a, 1984b, and 1985a). It is important to emphasize, however, that (1) all twins chosen from the original sample to complete the tasks (34 MZ twin pairs and 13 DZ twin pairs) had obtained IQ scores that were equal to or above the population mean of 100, and (2) the majority of pair members were concordant for IQ score, as defined by the "typical" MZ within-pair difference of 6 points (Plomin & DeFries, 1980); several pairs differed by 7 to 8 points.

Freedman (1979) has observed that "the proper level of neurobiological growth must be achieved before kinship and other comparable abstractions can be dealt with." Twins who completed the experimental battery ranged in age from 6.09 years to 11.30 years, with a mean age of 7.94 years (s.d. = 1.37). This age span is approximately congruent with Piaget's period of incipient cooperation (7 to 11 years), which is characterized by the mastery and application of existing rules and a capacity for cooperative activity.

Twin pairs were observed while jointly engaging in a series of experimental games and tasks. The two major hypotheses are provided below. Cooperation and altruism are defined with reference to social-genetic and kinship-genetic theories of behavior; these definitions are by no means exhaustive.

1. Cooperation during a joint task will be displayed more frequently by interactants with identical genotypes (MZ twins), relative to interactants with nonidentical genotypes (DZ twins). MZ twins are expected to work toward fulfilling common goals, while DZ twins are expected to pursue more individually defined goals.
2. MZ twins are expected to display greater readiness to share, and to forfeit possessions or prizes for the co-twin, in the absence of external rewards, relative to DZ twins.

It was expected, however, that not all MZ pairs would be similarly demonstrative with respect to displays of cooperative behaviors. The specific *form* of the behaviors did prove variable between pairs, reflecting what can be called the special “twin pair culture,” most likely fashioned by the genetic and environmental influences unique to each set. These observations, while of interest to the genetics of social behavior, are beyond the scope of this chapter.

The experimental battery sampled twins’ behavior across multiple contexts: experimental activities (games and tasks) and observations of free play in naturalistic settings (Nearest Neighbor Study). Two experimental activities, puzzle completion and the differential productivity task, are described below.

Puzzle Completion Task

A puzzle was placed at an equal distance between the two twins, who were asked to “complete the puzzle together.” These segments were filmed by the investigator, using a Kodak Supermatic 8 mm camera, to enable more fine-grained analyses of behavior. All 47 films were reviewed by two judges (the investigator and a trained graduate student assistant).

Results are summarized in Table 6.1. A significantly greater proportion of MZ (94%) than DZ (46%) pairs finished the puzzle ($p < .0007$). Age and gender were not significantly correlated with success on this task. Given that all twins had obtained above-average IQ scores and all pairs were IQ-concordant, it seems certain that all subjects had the ability to complete the task at an *individual level*. When working in pairs, however, the MZ twins combined their efforts effectively, whereas DZ twins were less able to do so. This provides a compelling illustration of the social-genetic concept that genotypes may influence social interaction in a manner apart from individual performance.

The relatively greater success of the MZ twins on this task reveals little, however, with respect to behaviors and strategies possibly underlying twin group differences in this activity. Attention to these variables is a step toward uncovering clues to the mechanisms that might be associated with the contrasting outcomes. Examining the films proved

TABLE 6.1. Puzzle completion: MZ and DZ pairs.

	MZ	DZ	Total
Finish	32/27.49 (84) [94]	6/10.51 (16) [46]	38 [81]
Not finish	2/6.51 (22) [6]	7/2.49 (78) [54]	9 [19]
Total	34 [72]	13 [28]	47

Fisher Exact Test: $p < 0.0007$.

() Row percentages.

[] Column percentages.

/ Number to left is observed frequency; number to right is expected frequency.

[Source: Segal (1984a).]

very informative in this regard. The data were analyzed by a one-way analysis of variance with planned orthogonal contrasts.^{1,2}

1. The proportion of time that the puzzle was equidistant between co-twins was longer for MZ than DZ pairs [$p < .026$, one-tailed].
2. The proportion of time that the puzzle remained closer to one twin was larger for DZ than MZ pairs [$p < .059$, one-tailed].
3. The intrapair difference in the rate (gaze/minute) at which participants looked away from the activity was significantly larger for DZ than MZ twins [$p < .015$, one-tailed].
4. The rate at which twins referred to (glanced at) the work of their co-twins was higher for MZ than DZ twins [$p < .035$, one-tailed].
5. MZ twins showed a higher rate of positive facial expressions than DZ twins [$p < .005$, one-tailed]. Age correlated significantly with displays of this behavior [$r = .35$, $p < .021$].
6. MZ pairs exhibited a higher rate of passive physical gestures than DZ pairs [$p < .07$, one-tailed].
7. The rate at which aggressive physical gestures occurred was higher for DZ pairs than MZ pairs [$p < .002$, one-tailed].

¹MZ twins were additionally organized according to hand-concordance and hand-discordance for analyses of the experimental tasks. This was to determine if social-interactional differences were associated with possible laterality differences among pairs; neuropsychological research reports that hand preference may be associated with cerebral organization and cognitive functioning (Levy, 1981). This chapter reports results for MZ and DZ twin pairs only.

²In the event that age correlated significantly with the dependent variable, an analysis of covariance, with age as the covariate, was performed. Skewed distributions were normalized by a natural log transformation. Planned orthogonal contrasts: MZ pairs with DZ pairs; MZ hand-concordant pairs with MZ hand-discordant pairs.



FIGURE 6.1. Monozygotic male twins, age 9 years, 4 months, engaged in a joint puzzle completion task. Photo by Nancy L. Segal, Ph.D.

8. Mutual displays of positive affects, upon completion of the puzzle, were observed more frequently among MZ pairs than DZ pairs [$p < .002$, one-tailed].
9. Among pairs that completed the puzzle, DZ twins worked faster than MZ pairs [$p < .078$, two-tailed], a result that was contrary to expectation; see discussion below. Older pairs worked faster than younger pairs [$r = -.46$, $p < .005$].

Figures 6.1 and 6.2 show MZ and DZ twin pairs engaged in the completion of the puzzle. The MZ co-twins work cooperatively, relative to the DZ co-twins, who essentially display an individual approach to this task. Greater attention to the task and awareness of one another were displayed by MZ twin pairs in this study, behaviors that may be implicated in their more successful outcome. These findings do, however, raise the possibility of more similar treatments and expectations for MZ twins than DZ twins. Some key environmental variables (accuracy of parental diagnosis of zygosity, perceived resemblance by twins themselves, membership in a twins club, and parental encouragement toward general behavioral similarity or dissimilarity) were unrelated to outcome on this task. These results suggest that explanations of twin group differences in joint activity (and differences between other social dyads) must take the relative genetic similarity of the pair members into consideration. It was observed that the successful DZ twins worked somewhat faster than the MZ twins. Further review of these filmed segments revealed that, in these cases, the puzzle was essentially solved by one child.



FIGURE 6.2. Dizygotic female twins, age 6 years, 2 months, engaged in a joint puzzle completion task. Photo by Nancy L. Segal, Ph.D.

Differential Productivity Task

The design of this task was suggested by research reported by Madsen (1967). Twins were instructed to trace (or outline) as many “trees” as possible, within a one-minute time limit. The number of trees outlined would determine the number of points won. This experiment was conducted under two sets of conditions, competitive/cooperative and together/apart: competitive (participants work for themselves); cooperative (participants work for their co-twins—the completed work determines the number of points earned for the co-twin); together (twins work in the same room, but are unable to see the work of the co-twin); apart (twins work in separate rooms). This design yielded four situations:

Competitive, twins together
 Competitive, twins apart
 Cooperative, twins together
 Cooperative, twins apart

Axelrod and Hamilton (1981) have provided insightful commentary on the Prisoner's Dilemma game, which is useful to understanding the twins' situation in this game:

The problem is that while an individual can benefit from mutual cooperation each can also do even better by exploiting the cooperative efforts of others . . . No matter what the other does, the selfish choice of defection yields a higher payoff than cooperation. But if both defect, both do worse than if both had cooperated (p. 139).

TABLE 6.2. Twin group scores on differential productivity task.

Person	MZ	DZ	MZ-DZ	Total
<i>N</i> (pairs)	34	12		
Self	28.67	29.98	-1.31	29.01
(s.d.)	(7.39)	(6.45)		
Twin	24.98	20.25	4.75	23.75
(s.d.)	(8.22)	(10.74)		
Self-twin ^a	3.69	9.73	6.04	
Total	26.93	25.12		26.38

^a $p < .019$ (MZ < DZ).

[Source: Segal (1984a).]

Axelrod and Hamilton (1981) also allude to the increasing diversity and sophistication of game-playing strategies found in association with the increasing neural complexity of the interactants. This is especially true in the case of organisms with a shared social history.

The unit of analysis in the differential productivity task was the Self-Twin score. Smaller average differences in the quantity of work output for self and twin were associated with greater altruism.^{1,3} The results, summarized in Table 6.2, show that while twins worked harder for themselves than for their co-twins [$p < .0001$], *MZ twins worked harder for their co-twins than DZ twins* [$p < .02$; directional hypothesis]. Productivity (for self and twin) was lower when working together, but only if working together occurred first [$p < .005$].

The differential productivity task corroborates the findings of the puzzle completion task in that genetic homogeneity was associated with greater cooperation than relative genetic heterogeneity. The concept of "greater restraint of selfishness" (Axelrod & Hamilton, 1981) is perhaps the most accurate description of what took place. Regardless of zygosity, the children labored more intently for themselves than their twins across situations. The MZ twins, however, worked harder for their co-twins than the DZ twins, suggesting that a more altruistic spirit is operative among them. The statements provided by the mother of MZ twins and the DZ triplet in the introduction to this chapter becomes especially meaningful in light of these findings.

GENETIC RELATEDNESS AND PREFERRED SOCIAL INTERACTANTS

It has been said that, in its haste to step into the twentieth century and to become a respectable science, Psychology skipped the preliminary descriptive

³The data from this experiment were analyzed by a multivariate analysis of variance with repeated measures. The design included three between-group factors (zygosity, handedness, order), and two within-subject factors (condition, person for whom work is performed).

stage that other natural sciences had gone through, and so was losing touch with the natural phenomena (Tinbergen, 1963, p. 411).

Naturalistic observation of interactions within nonhuman social primate groups has revealed that the frequency of spatial proximity and social exchange (including altruistic acts) are associated with degree of kinship (Cheney et al., 1986; Kummer, 1968; Kurland 1977). Several such studies of human social behavior have also been reported. Chagnon (1979), in his studies of Yanomamo villages, found that acts of assistance and defense were performed most frequently among individuals with relatively higher coefficients of relationship. When village residents reorganized themselves into smaller social units, these new villages were characterized by higher coefficients of relationship than the original village. Hames (1979) observed a linear relationship between the frequency of interaction among members of the Ye'kwana of Venezuela and their degree of genetic relationship. These studies are provocative because they direct attention to a generally neglected variable (genetic relatedness) as possibly underlying the apparent "social specificity" of peer-related activities (see Strayer et al., 1979).

Reports of twins' social behaviors in unstructured settings (what I call "twins in the wild") have, unfortunately, primarily consisted of case studies or unsystematic observations. The Nearest Neighbor Technique, developed for the study of social and spatial affinities within troops of hamadryas baboons (Kummer, 1968), provides a viable method for comparing these behaviors between identical and fraternal twins. (This technique has been successfully adapted to analyses of play preferences among young school children [Omark, 1972]). Sociobiological theory predicts that MZ co-twins should (1) be located at closer physical distances and (2) engage in more frequent social contacts, relative to DZ twins.

Nearest Neighbor Study

Twelve pairs of twins (8 MZ twin pairs [4 hand-concordant and 4 hand-discordant] and 4 DZ twin pairs) were observed in playground situations during recess periods at school (one MZ pair was observed during a free play period in the classroom).⁴ Male and female pairs were equally represented within zygosity groups. Observation periods ranged between 12.30 minutes and 31.30 minutes, with a mean time of 20.77 minutes. Two observers (the investigator and an assistant) position

⁴The Nearest Neighbor Study compared three twin groups: MZ hand-concordant, MZ hand-discordant, and DZ hand-concordant. The two MZ twin groups showed greater social affiliation than the DZ group, but there was some suggestion that the MZ hand-discordant group was highest on these measures. Additional cases are required to determine if twin bonds are substantially strengthened by possible behavioral differences, associated with differences in laterality in genetically identical twin pairs.

themselves on the margin of the play area to conceal themselves from the children. Each observer recorded the behaviors of one member of the pair ("target twin"). Both observers wore separate earphones attached to a common device which emitted a tone at 10-second intervals. The following events were recorded:

1. Nearest neighbor + interaction
2. Second nearest neighbor + interaction
3. Third nearest neighbor + interaction
4. Nearest neighbor, no observable interaction
5. Second nearest neighbor, no observable interaction
6. Third nearest neighbor, no observable interaction
7. Verbal interaction, lack of spatial proximity
8. Nonverbal interaction, lack of spatial proximity
9. Observation uncertain
10. Absence of both spatial proximity and interaction

Nearest neighbor indicates that the co-twin was closest to and/or interacting with the target twin. *Interaction* was defined as either verbal contacts (talking, laughing, shouting) or nonverbal contacts (looking, hugging, holding hands). The term *no observable interaction* (items 4, 5, and 6) is preferable to *chance encounter* because the available methods are not yet sufficiently sensitive to distinguish between them. It is possible that the failure to demonstrate observable social behaviors may have very different implications between pairs whose members may, or may not, be closely associated spatially.

The Kruskal-Wallis One-Way Analysis of Variance by Ranks was used to evaluate the predictions specified above. Group differences were significant for the proportion of 1's out of the total number of observations available per pair. MZ hand-discordant twin pairs scored highest, followed by MZ hand-concordant twin pairs and DZ twin pairs. Twin group rankings for variable 1+2, and for 1-1 and 1-2 (simultaneous recording of 1 or 2 for each co-twin) followed the same pattern with differences that approached, but did not achieve, statistical significance. The MZ twins exceeded the DZ twins on all measures, with the exception of 0's and matched 4's. Sex differences were not detected on any of the measures.

The greater preference that MZ twins showed for the company of the co-twin than DZ twins showed for their co-twins is testimony to the social and, possibly, emotional gains available from the company of a very close relative. DZ twins, in comparison, apparently prefer to socialize outside the twinship. There was, in fact, one DZ female pair who accumulated *all zeros* during 15.3 minutes of observation, indicating a *total absence of social interaction*. This result provides striking contrast to the members of an MZ male pair, one of whom entered the playground (from a different classroom) in search of his brother. He was unable to

locate his brother immediately, and wandered throughout the play area wearing a pained expression. Upon identifying his twin, he broke out into a joyous smile, and the brothers proceeded to swing around a pole in synchronized motion.

The only measure which distinguished between twin groups included social interaction *together with* close physical proximity. Social interaction may, therefore, imply a more purposeful form of affiliation than is possible from physical proximity alone. Additional research addressed to the meaning of physical closeness between MZ and DZ co-twins is clearly needed.

Once again, the quotations cited in the introduction to this chapter acquire significance in light of results from the Nearest Neighbor Study, especially the two episodes described. Ethological methods are surely a powerful means for capturing the very subtle and meaningful aspects of twin interactions. They are, in particular, a viable means for reconciling experimental settings with the natural life situation. It is emphasized that this phase of the investigation of twin relationships must be considered as a pilot study. Additional research along these lines would be welcome.

Death of a Twin

Barash (1979) suggested that in the despair of parental bereavement following the loss of a child, we hear "the wail of frustrated genes."

But why *do* we grow to love a child? Perhaps because the older it is, the more clearly it represents our evolutionary future. As with love between parents, love of parent for child is highly adaptive. Genes that decide to invest preferentially in the right offspring in the right ways and at the right times will ultimately produce more successful offspring than will those which follow less adaptive strategies. As a result, those successful genes and their bodies will be more fit, and eventually the majority of the population will have these traits. We already have a name for the mechanism that ensures appropriate parental investment; it is a universal behavioral means to a biological end, and we call it love (p. 99).

Interest in individual differences in behavioral and physiological reactions to bereavement has burgeoned within recent years. Research efforts by the National Institute of Mental Health have culminated in a valuable resource, *Bereavement: Reactions, Consequences and Care* (Osterweis, Solomon, & Green, 1984). A sociobiological perspective, while not purposefully included in this text (or in the majority of literature on bereavement) is nevertheless undeniably present: parental grief is less for younger children than older children (Roskin, 1984); loss of a child is experienced more intensely than loss of a parent or spouse (Sanders, 1980). The single analysis of bereavement reactions, specifically based upon sociobiological theorizing, is a study of parental grief

intensity following the loss of a child (Littlefield & Rushton, 1986). A compelling finding of special relevance to analyses of twin loss is that *parents grieved significantly more for children whom they perceived as resembling their side of the family more than their spouse's family.*

Given the evidence to support the bond between genetically identical twins as the strongest of human ties, sociobiological theory would predict that surviving members of MZ twinships should "wail the loudest" for their lost genes, *louder than any other biological relative.* Consider a statement by a surviving MZ twin in a study by Woodward (1986): "Watching my twin die was the equivalent of watching myself die." This might, at first, seem inappropriate, because the MZ twin partner does not immediately appear to represent one's evolutionary future. The unusual relationship between the offspring of MZ twins (described earlier), however, lends an intriguing dimension to this issue: the children of MZ twins are the genetic equivalents of half-siblings. This means that own children are as closely related to the twin parent as are nieces and nephews. This holds equally in the case of twin mothers and twin fathers (although in the case of fathers, it is possible that uncertain paternity may eventuate in less close relationships). In this regard, I was recently impressed by the ease with which a 27-year-old MZ twin female assumed the responsibility for raising the infant of her deceased twin. A similar case concerns a family constellation including MZ female twins and their spouses. It was recently determined by these families that, in the event of death to one couple, the other couple would raise their children. They explained that this seemed the most "natural arrangement," despite other brothers and sisters in the family. These situations share characteristics with an extreme form of "sororal polygyny" (Barash, 1979) in which sisters marry the same man. When co-wives (parallel to the wives of MZ male twins) in these societies help each other's children, they are "helping to perpetuate their own genes."

The unusual relationships afforded by MZ twin families would not, however, be present in the families of DZ twins, whose children share the same genetic relationships as ordinary cousins. DZ twins who shared a relatively high proportion of their genes in common might, however, be expected to approach the situation of MZ twin families; methods for organizing DZ twins according to percentage of shared genes are available (Dumont-Driscoll & Rose, 1983). These particular family constellations have been enormously valuable in behavioral genetic analyses of intellectual and physical characteristics (Magnus, Berg, & Bjerkdal, 1985; Rose, Harris, Christian, & Nance, 1979). No one has, unfortunately, attempted to explore the quality of social relationships in these unique families—such efforts would clearly represent a key contribution to human sociobiological theorizing. Examining friendships among half-siblings in MZ twin families, as compared with first cousins in DZ families, for example, might enhance understanding of the biological and cultural influences on preferred social partners.

The developmental level at which the death of a close relative occurs appears to be strongly associated with its effects (Krupnick, 1984). Just as in the case of child loss, it is possible that the loss of a twin in adolescence is experienced more severely, because these individuals have achieved the stage of reproductive potential. The psychological aspects of twin loss in adolescence might be said to mirror the evolutionary processes associated with child loss.

RESEARCH ON TWIN LOSS

At the 1986 meeting of the Society for Traumatic Stress Studies, Dr. Mardi J. Horowitz, from the Langley Porter Psychiatric Institute, in San Francisco, California, indicated that the greatest loss was that of a spouse or a child. However, little systematic study of the psychological and behavioral sequelae of twin loss, as compared with the loss of other relatives, or its possible differential significance in the lives of MZ or DZ twins has been undertaken. The few available findings, as well as ongoing research at the Minnesota Center for Twin and Adoption Research, pose considerable challenge to Dr. Horowitz's remark. There is growing evidence that the death of an identical twin may represent the most traumatic form of loss to an individual.

A study of affectional adjustment in high school twins (Mowrer, 1954) asked which family member would be missed most in the event of death. Mothers were selected most often, followed by the twin and father. When twins were organized according to zygosity, it was found that MZ twins named their co-twins most often (49%), as compared with DZ same-sex twins (25%) and opposite-sex twins (13%). This same pattern of results emerged in response to the question: Who in the family best understands you? In another study, MZ twins experienced twin loss more severely than DZ twins (Woodward, 1986). Unfortunately, the psychological effects of twin loss, relative to the loss of other relatives was not examined in that study.

Case histories are especially informative as to the sense of loss and continuing difficulties confronting many twins who have lost their twins. These themes are clearly conveyed by psychiatrist George Engel (1975), who described the wonderfully close bond shared by himself and his MZ twin brother. He reveals that his motivation to prepare the article derived from his need to reactivate his lost twinship: "I can again enjoy being a twin and telling twin stories." This simple statement is powerful testimony to the universal human need to "reconnect" with one's biological roots. The same remarks have been voiced by singleton twins who have returned to twins clubs, or have engaged in support groups composed of surviving twins. It is a recurrent theme in many of the interviews and much of the correspondence which I have conducted, not only with singleton twins, but also with reared-apart twins and twin holocaust survivors (see below). It may explain, at least in part, why

some twins whose twins have died at the time of birth still feel the loss so intensely. In a study by Woodward (1986) 84 of 219 twins had lost their twins within the first six months of life. The majority of available case material or personal documentation has been written about or by MZ twins. This is highly suggestive of the differential loss experienced as a function of zygosity.

It is curious that the sibling bond, in general, and the twin bond, in particular, have been largely neglected in the clinical and research literature on bereavement. Individuals who are currently stimulating efforts in this area are mostly twins, or closely associated with twins. An excellent review of parental response to the loss of newborn twins by Bryan (1986) has resulted from such efforts.

MINNESOTA STUDY OF TWIN LOSS

The Minnesota Center for Twin and Adoption Research is currently conducting a study for the purpose of understanding the experience of twin loss. This project was initiated in response to requests for information and assistance by twins who had lost their twin siblings. A questionnaire is mailed to twins identified through notices in twins club publications and newsletters, as well as personal contacts. (The sample may not be representative of twins who have lost twins, and should be regarded as a "collection of cases.") Items concerning the quality of the twin relationship, circumstances surrounding the twin's death, and responses to the event are included. Certain items have a purposefully sociobiological flavor. In particular, we assess immediate and current reactions to the loss of the MZ or DZ twin, and ratings of grief intensity for twin and other relatives and acquaintances who are deceased. Zygosity is assessed by items included in the Nichols and Bilbro (1966) questionnaire, and inspection of photographs when available.

Questionnaires have now been completed by 44 twins, including 25 twins from MZ pairs, 3 twins from same-sex DZ pairs, and 9 twins from opposite-sex DZ pairs. Zygosity could not be determined in some cases, due to loss of the twin at the time of birth or incomplete information. It is immediately interesting that MZ twins are highly overrepresented among the respondents, hinting at their greater investment in the twin relationship and greater suffering at the loss of the twin, relative to DZ twins.

Twins are asked to rate reactions to the death of the twin, and other relatives and acquaintances, during the first month or two following the event. The grief intensity scale is a 7-point scale which includes ratings of 1 (No Grief) to 7 (Total Devastation; Suicide Point), as cited in Littlefield and Rushton (1986). Restricting attention to cases in which loss of the twin occurred at age 15 years or later, and in which relatives other than the twin had died, we find that 16 of 22 MZ pairs (73%) rated

grief due to twin loss as *more intense* than the loss of other relatives. This is consistent with sociobiological predictions. In four cases, twins had died at age 50 or older, generally past the reproductive years. Additional cases will be needed to determine if loss of the twin at this stage is generally experienced less intensely. The DZ twin group was, unfortunately, too small to yield meaningful findings.

It was provocative (and somewhat unexpected) that loss of a twin in infancy or early childhood may have profound behavioral consequences for the survivor. Many such twins described feelings of “incompletion,” as well as an obsession with the lost twin and depression linked to this loss. (This may, however, reflect a sampling bias in that surviving twins who were relatively *unaffected* by loss of the co-twin in infancy may have been unmotivated to participate in the study.) It has been speculated that children under the age of 1 or 2 years show less distress than older children because of insufficient time to develop bonds (Rutter, 1966). It is therefore meaningful that parents of singleton twins often report delayed reactions by the surviving children, even as much as several years after the event (personal communications to the author). That difficulties associated with twin loss tend to persist throughout the lifespan suggests disturbance at the severing of a potentially important relationship. It will be informative to systematically compare twin loss with the loss of other siblings as our study progresses.

Studies of Twins Reared Apart

The brothers shook hands stiffly, when they saw each other for the first time. Then they hugged and burst into laughter. “I looked into his eyes and saw a reflection of myself . . . I wanted to scream or cry, but all I could do was laugh” (Jim Springer, New York Times Magazine, December 9, 1979).

Reunions between reared-apart twins are, perhaps, human sociobiology at its finest. An important and recurrent observation is that most newly reunited MZ twins, and some DZ twins, establish powerful bonds *despite absence of previous familiarity*. Time spent together is requisite to filling in specific life events, but the basis or readiness for the relationship appears to be present, often at the moment of meeting. It is as if these twins have known one another all their lives without having to be introduced. “I am him and he is me,” remarked a 31-year-old MZA male twin. His twin brother elaborated this sentiment by observing that his twin seemed only to have “been away” for 31 years; now that he “has returned, they can pick up where they left off.” At the time of assessment (10 months after their meeting) both felt “as close as best friends” and perceived the co-twin as “more familiar than a best friend.” Their adoptive siblings (who differed from the twins in age by two to four years, and with whom they had been raised all their lives) were rated as follows: “as

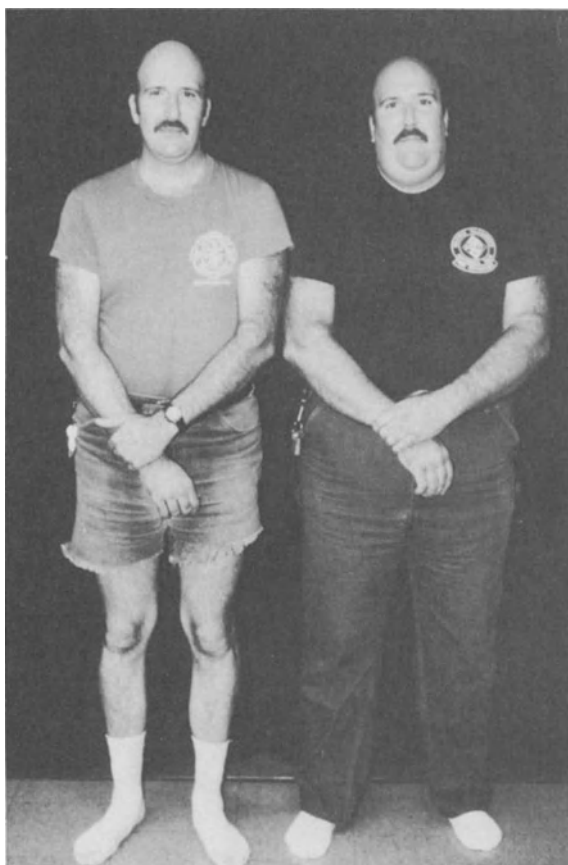


FIGURE 6.3. Monozygotic reared apart male twins, age 32 years; separated at 3 days, reunited at 31 years. Photo by Thomas J. Bouchard, Jr., Ph.D.

close as someone whom I meet for the first time; as familiar as a casual friend” and “as close as a casual friend; more familiar than a best friend.” Another recently reunited MZA female pair were pleasantly aware of their behavioral similarities only minutes after meeting (T.J. Bouchard, Jr., personal communication, 1982). MZA and DZA twin pairs who have participated in the Minnesota Study of Twins Reared Apart are shown in Figures 6.3 and 6.4.

Case histories of 16 of the 19 MZA pairs reported by Newman, Freeman, and Holzinger (1937) reveal that, following reunion, six pairs chose to live together and/or to become associated professionally, and nine pairs maintained close contact. In contrast, only a single pair elected not to pursue the twin relationship. This is particularly impressive given that many of these individuals had been previously unaware



FIGURE 6.4. Dizygotic reared apart female twins, age 44 years; separated at 10 days, reunited at 44 years. Photo by Nancy L. Segal, Ph.D.

of the existence of a twin sibling. DZA twins were not included in the Newman et al. study or in two other studies of reared-apart twins (Juel-Nielsen, 1966; Shields, 1962). DZA pairs are, however, recruited by the Minnesota Study of Twins Reared Apart.

The foregoing observations are completely consistent with results from kin recognition studies of animals raised apart, summarized by Barash (1982) and Rushton, Russell, & Wells (1984). In the majority of these cases, recognition and social preference were displayed more frequently toward relatives than nonrelatives, despite separate rearing situations. Parallels between human and nonhuman behavior should not be confused with proof that recognition processes similarly operate across species. Such findings should, however, be admitted into human behavioral science disciplines as serious directions for future inquiry.

Observations on reunited twins and other adoptees acquire further meaning in light of an enhanced version of kin selection, called genetic similarity theory (GST) (Rushton et al., 1984, p. 179). GST states that, "organisms are able to detect other genetically similar organisms [not just relatives with whom genes are shared by descent] and to exhibit favoritism and protective behavior toward these strangers, as well as toward their own relatives." It is important to appreciate that, on average, increasing genetic relatedness is associated with increased physical and behavioral resemblance. A basis for social bonding may therefore be provided. Thissen and Gregg (1980, p. 111) suggest that the flow of altruistic behaviors, the ease of information transfer, and the genetic benefits of positive assortative mating are linked to the degree to which interacting individuals share homologous genes." They suggest that this reasoning applies to friendships, as well.

The experience of adoptees provides an informative human experimental arena for assessing sociobiological predictions. It is, for example, tempting to speculate as to *why* the identification of unknown kin is important. Reviews of studies in this area reveal that biological relationships within families may be more firmly cemented than nonbiological relationships (Freedman, 1979), and that people prefer to raise their own children, rather than adoptive children (Barash, 1979). Step-parenting has, in fact, been associated with elevated risk of child abuse (Lightcap, Kurland, and Burgess, 1982; Wilson, Daly, and Weghorst, 1980). Feelings of "inner emptiness" by adoptees, regardless of the quality of the adoptive home environment, have been reported (Triseliotus, 1973). It is, therefore, relevant that the majority of twins separated at birth have been placed in adoptive homes. This life situation could, conceivably, underlie the joyous reunions that have been described. If, however, we consider that possible recognition mechanisms may be operative between MZ co-twins and other close kin, this explanation seems, at best, incomplete. Many of the twins in the Minnesota Study of Twins Reared Apart have, in fact, come from loving adoptive homes and some postponed a search for the twin until after the death of the adoptive parents to avoid the possibility of hurt feelings. It is also possible that, having grown up with nonbiological relatives, these twins have learned to become more highly adaptable, an idea proposed by Scott (1977). Ease of entering into the twin relationship, even as adults, may be associated with this feature of their life history.

My colleagues and I have observed that the search for the twin is, in most cases, very keen, despite considerable emotional and financial expenditures. Freedman (1979) has raised the possibility of a biological mechanism related to the continuity of kinship lines. In other words, do efforts to locate kin vary in intensity as a function of degree of genetic relatedness? I often ask individuals if they would search for a hypothetical relative (e.g., a cousin) whom they have not met. The answer is typically an uncertain grin. A parent or sibling generally

receives greater enthusiasm. A reared-apart identical twin, however, is usually met with an unmistakable gleam in the eye, a smile, and an emphatic yes! Most everyone admits that the idea of a genetically identical twin seems difficult to resist. Why this should be, however, is a fascinating, but complex matter to resolve.

In the Minnesota Study of Twins Reared Apart, we have observed that a search may be initiated with the aim of finding a parent, but if the existence of a twin is revealed, the importance of locating the parent usually diminishes, relative to the twin. Other brothers and sisters do not appear to engage the same degree of energy and intensity invested in the search for the twin.

MINNESOTA STUDY OF TWINS REARED APART

A comprehensive twin relationship survey was introduced into the standard assessment battery in 1982, the fourth year that the Minnesota Study of Twins Reared Apart was in progress. It has now been completed by 18 MZA twin pairs, 1 set of MZA triplets, a second set of triplets (composed of an MZA female twin pair and DZA male), 1 member of a set of Swedish triplets (composed of an MZA female twin pair and DZA male), 13 DZA same-sex twin pairs and one DZA opposite-sex twin pair; earlier twin pairs will, hopefully, complete this part of the study by mail, or at planned 10-year follow-up visits.

Questions from the twin relationship survey address the adoptive life history, adoption experience, the search for the twin, and the current and future twin relationship. Many of the items were generated in accordance with sociobiological theory, as was true of the twin loss survey. Some examples from the survey are provided below:

When I met my twin for the first time, my *first impression* was that we would become:

- a. closer than best friends.
- b. as close as best friends.
- c. less close than best friends, but closer than casual friends.
- d. as close as casual friends.
- e. as close as most people I meet for the first time.
- f. less close than most people I meet for the first time.

When I met my twin for the first time, my twin seemed:

- a. more familiar than a best friend.
- b. as familiar as a best friend.
- c. less familiar than a best friend, but more familiar than a casual friend.
- d. as familiar as a casual friend.
- e. as familiar as most people I meet for the first time.
- f. less familiar than most people I meet for the first time.

These same questions are repeated later in the interview schedule, but in the present time frame.

The reared-apart twin sample for whom these data are currently available is too small to provide definitive findings. Preliminary examination of responses to the questions given above are, nevertheless, suggesting greater expectations of closeness and greater immediate familiarity among MZA twins, relative to DZA twins. This is only true, however, if we compare the proportions of twins endorsing choice (a) “closer than [or more familiar than] best friends.” These trends are consistent with sociobiological theorizing, in which affiliation and recognition are associated with genetic commonality. While such findings would be striking in twins reared together, our findings on twins reared apart are even more provocative because *many twins were unaware of the existence of a twin until adulthood*. More detailed analyses will be needed to identify factors in the rearing environments of the twins that may be associated with the apparent twin group difference. It is the case that some individuals had known for some time that they were twins, but were uninformed as to zygosity.

The MZA twins often inform us that their children are very much alike and seem to “get along well” with their new cousins (really half-siblings). Unfortunately (for purposes of research), the children of the twins meet either at or shortly after the twins’ reunion. It would be beneficial to sociobiological theory to determine if these “cousins” would be selected as friends from a random group of children. Standard photographs of the co-twins’ children and unrelated children, matched for age and sex, could be presented to cousins who would indicate their friendship preferences. Similar research designs could be employed to examine possible bases of friendship among young children; photographs could vary in the degree to which they resembled the participant.

Chagnon and Bugos (1979) have identified crisis or conflict events as most revealing with respect to the nature of social relationships, given their clear costs and benefits. Fortuitous events, however, may be similarly informative about the quality of social affiliation and preference. Reunions between separated relatives, especially MZ twins, are probably the most potent and poignant expressions of human connectedness.

Twin Survivors of the Nazi Holocaust

This chapter concludes with a sociobiological appraisal of a recent and unique event: the 40th anniversary reunion of twin survivors of the Nazi Holocaust (January 27-February 6, 1985). These twin children were the unfortunate victims of brutal medical experimentation conducted at the Auschwitz-Birkenau concentration camps, in Poland, by Dr. Josef Mengele. The events responsible for this reunion, and those that have followed, forcefully echo many of the themes discussed: the search for one’s roots and the need to reconnect with one’s biological

origins. The twin children, "now come of age," are enormously informative if we follow their story.

CANDLES (Children of Auschwitz Nazi's Deadly Laboratory Experiments Survivors), founded in 1983 by Mrs. Eva Kor, represents the organization of Auschwitz twins. It is estimated that of the 1,500 twin pairs to have passed through Auschwitz-Birkenau between May 1943 and January 1945, only 157 individuals (representing both intact and nonintact twin pairs) have survived. At present, approximately 110 twins have been identified. The reunion, which marked the 40th anniversary of the liberation of Auschwitz-Birkenau, included a four-day visit to the death camps, followed by a three-day public hearing, in Israel, on the crimes of Dr. Mengele. I was privileged to attend this reunion as a member of the Minnesota Center for Twin and Adoption research.

In "Holocaust Twins: Their Special Bond" (Segal, 1985b), I examined the nature of the twin relationship between and among survivors by means of interviews with 24 twins. In this chapter, I will attempt to extract the most salient themes, and to evaluate them in light of sociobiological theory.

The key factor underlying emotional and physical survival at Auschwitz was the presence of a twin. The twin served a dual function: First, Dr. Mengele was not interested in singleton twins in his experiments. The death of one twin (regardless of cause) typically signaled the death of the other twin for purposes of comparative pathology (Nyiszli 1960). The twins were aware of this, such that keeping the twin *and* the self alive, even at great risk, assumed equal importance. Second, the presence of the twin provided a source of friendship and support. Twins were, in fact, "better off" than other inmates in this respect, in that family members were typically placed in separate barracks. It appeared that twinship at Auschwitz, and in the years that followed, was a highly valued relationship for both MZ and DZ twin pairs. The social-interactional differences typically observed within MZ and DZ twinships appear to have been attenuated. That is to say, both MZ and DZ twin pairs emphasized their close, lifelong affiliation. Hamburg (1977) has emphasized that under extreme conditions, individual differences may become obscured. It seems likely that this was the case with the MZ and DZ twin survivors of Auschwitz.

Physical and situational similarities, comparable to those observed between MZ twins, have been used to explain social bonding in other instances. The communality and mutual support between poliomyelitis patients has been described as that of "twinning" (Brewster, 1957, cited in Leonard, 1961). The camaraderie and identification with common needs and anxieties observed among six young orphans, following World War II, also assumed a "twin-like" quality (Freud & Dann, 1951). Parallels have been drawn between twin relationships and relation-

ships among kibbutz children raised together from birth (Bettelheim, 1969). Greenson (1968) has claimed that young adults do not seek boy-friends or girlfriends, but twins: "They are secure only with someone who resembles themselves." He associates twinship with "sameness, familiarity, and security." The important point is that identity with respect to physical or situational events seems critical in the establishment and perpetuation of social ties, a common feature of identical twinship. The effects of the Holocaust situation on the twin relationship is more comprehensible in light of the foregoing. It is also understandable that many "twinlike" relationships developed between non-twin survivors.

A common motivation among the twins for attending this reunion was not only to identify fragments of the past but, more important, *to be identified* by someone. There was a desire for the twins to again become the children they had once been, when they had parents and siblings. Visits to places such as the railroad ramp at Birkenau, at which parents and children experienced their final separation, constituted legitimate and meaningful reunions. Hours were spent at the archives at Auschwitz examining files and photographs. Photographs have become priceless in value: "These are my roots."

Several twins attended the Auschwitz reunion in the hope of finding the twin siblings and other family members from whom they had been separated. These twins clung to the belief that their twins might still be alive. "Every time we meet another twin it is like finding another piece of ourselves." This familiarity undoubtedly triggered activities to assist certain twins in need. Following the reunion, nationwide appeals for kidney donors were undertaken for the benefit of a twin suffering from kidney failure, possibly linked to death camp experiments.

Reciprocal altruism (the exchange of altruistic acts whereby benefit exceeds cost so that eventually both partners gain) and the conditions conducive to its occurrence (Trivers, 1985) are complex issues for behavioral scientists. There is abundant evidence of altruistic activities at the human level among individuals who are unrelated (e.g., charities and donations), events which seem at odds with sociobiological theory. Reciprocity in friendship has been well documented by Youniss (1986), who has examined its development in children between 6 and 13 years of age. Factors underlying the "selfless rescue" of Nazi victims by righteous Christians have also been the focus of a recent study (Tec, 1986). The Holocaust twins raise the additional intriguing issue of how and why altruism may be directed toward individuals with whom one has interacted in childhood (e.g., rescuers or fellow inmates), but with whom one has not maintained continued contact. Trivers (1985) asserts that reciprocal altruism has importantly influenced the course of human evolution: "Although kinship often mediates many of these acts, it never appears to be a prerequisite. . . . The emotions of friendship, moralistic

aggression, gratitude, and sympathy, as well as our sense of fairness, probably arose primarily as mechanisms to regulate reciprocal altruism" (pp. 386–393).

The situation of the Holocaust twins can be accommodated, in part, by a sociobiological framework if we consider the reasons for reunion attendance and what the twins hoped to accomplish: the search for roots and a re-creation of childhood. This does not, however, appear to differ significantly from motivations to attend family and high school reunions—there is a sweet pleasure that is uniquely available from events concerning our pasts. It is impressive that the desire of the Holocaust twin survivors to return to the scene of final separations from family should remain such a driving force after 40 years, especially when common sense dictates against recall of those tragic times. Greater understanding of these activities may improve our ability to treat children exposed to various traumatic events, especially those involving separation from family and familiar surroundings.

Overview

The introduction to this chapter promised a demonstration of the usefulness of examining human behavioral development in light of sociobiological reasoning. It was proposed that a richer, more meaningful conceptualization of social behavior would emerge as a result of such efforts. Evidence from a variety of twin studies strongly suggests that the relative genetic backgrounds of individuals may importantly influence the nature and outcome of social-interactional processes. These findings are not limited to members of twin pairs, but appear to have significance at many levels of human social organization and activity. The consistency of findings in support of a genetic influence on social behavior poses important theoretical implications.

THEORETICAL IMPLICATIONS

The steadily accumulating evidence that genetic factors are important to social-interactional behaviors, such as cooperation and competition, indicates that explanations resting solely on environmental factors are misleading. Child development researchers and others are, happily, becoming increasingly sensitive to the likely gains available from the work of more biologically oriented colleagues. Recent examples are *Altruism and Aggression: Biological and Social Origins*, edited by Zahn-Waxler et al. (1986), the culmination of a 1982 conference organized by the Society for Research on Child Development and the Child Development Foundation, and *Sociobiology and Psychology: Ideas, Issues and Applications*, edited by Crawford, Smith, & Krebs (1987). Buss (1987)

has formulated several evolutionarily based hypotheses concerning parent-child interaction that are amenable to testing by behavioral genetic methods. The new climate of the field is expressed by Cairns & Valsiner (1984) and Cairns (1986): "The challenge for contemporary research is to determine how this integration [of biological concepts into child psychology] is achieved at each ontogenetic stage and how different weights should be assigned over the course of development" (p. 60).

Twin researchers continue to be excited by the power of twin designs for examining biological and environmental influences on human behavioral development (Bouchard, 1984; Bouchard, Lykken, Segal, & Wilcox 1986; Bouchard, 1987). The "societal" nature of twin relationships has been acknowledged for some time (Mittler, 1971; Shields, 1954). Sociobiology has stimulated recent creative and informative ways of utilizing twins in studies of social behavior. The absence of this design from the child development research on cooperation, competition, and altruism is, therefore, somewhat surprising. Some important work has been done on the early emergence of altruistic displays (Eisenberg, 1982). However, the further definition of trends in the development of cooperation and altruism (Marcus, 1986) and the identification of age-appropriate tasks (Krebs & Russell, 1981) are areas that could profit from longitudinal analyses of twins. Developmental profiles describing the intellectual and physical growth of MZ and DZ twins have been examined by Wilson (1983, 1986) in the Longitudinal Louisville Twin Study.

Freedman (1979) has suggested that MZ twins may represent an exaggerated version of an inbred population. Twinship as a microcosm of human society is, therefore, a reasonable conceptualization. Comparative studies of MZ and DZ twins may, thus, provide a viable research design for investigations of social processes occurring at the population level. They offer, in particular, a magnified view of interactions occurring within genetically homogeneous and heterogeneous groups. Consider, for example, the ease of adoption within relatively highly inbred societies, such as Japan, and the close social networking among the Navajo (Freedman, 1979). Observations such as these suggest that group unity in classrooms or nations may be influenced by the relative genetic backgrounds of the members. These hypotheses will, hopefully, generate studies to tease out specific factors associated with group cohesion; this knowledge might be used to help foster unity between relatively diverse groups. Counter examples, such as successful transracial adoptions, can certainly be raised (see Sorosky, Baran, & Pannor, 1984, and references therein). Such cases do not weaken the argument, but rather speak to the wide range of behavioral diversity and plasticity that exists within the human species. As Freedman (1979) has so aptly phrased it, we are all "variations on the common human theme."

I have suggested elsewhere (Segal, 1984a) that a fruitful research design might include pairs of twin children who are members of different twin pairs (i.e., Twin 1, Pair A and Twin 1, Pair B). This would highlight the effects of a shared social history with a genetically identical and nonidentical partner, affording an interesting extension test of Scott's (1977) research. These designs could also include individuals from different social backgrounds and cultures. The effects of social experience with genetically similar and dissimilar individuals upon current social behavior and adjustment could be addressed.

The research reviewed on separated twins, adoptees, and Holocaust survivors highlights a possible human tendency to seek out one's biological beginnings. A participant on a recent radio talk show commented that Alex Haley's book, *Roots*, has stimulated human interest in tracing genealogies and locating biological relatives. A more appropriate interpretation may be that it *reflects* the need for human connectedness. Research on the social adjustment of adopted children should proceed with this in mind.

Conclusion

The twin data reviewed here, as well as data collected on other pairs of individuals of different degrees of genetic and environmental relatedness, are consistent with social-genetic and sociobiological predictions. It should be emphasized, however, that a genetic explanation for differential displays of cooperation, competition, and altruism is *not* proven. The identification of brain mechanisms and biological substrates associated with social behavior has, for example, been cited as a necessary endeavor for understanding behaviors such as altruism and aggression: "A scientifically compelling sociobiology cannot exist without an explicit marriage of the evolutionary and psychobiological perspectives for the study of social processes" (Panskepp, 1986, p. 22). Panskepp and his colleagues deserve encouragement, as do other investigators whose varied efforts are continuously shaping human sociobiology into a meaningful and more rigorous discipline. A recent article by Kitcher (1987) and accompanying peer commentaries debate the current progress and future directions of human sociobiological research.

Finally, it is important to recognize that *not all MZ and DZ pairs are expected to conform to "type" with respect to their social relationships*. The same reasoning extends to other types of biological and nonbiological relatives. A variety of biological, psychological, and psychosocial factors may carry particular weight in selected cases. The key point is that the available findings on twins are enormously informative with respect to the varieties of social relationships that may be anticipated for MZ and DZ twin pairs.

Acknowledgments. Professors Thomas J. Bouchard, Jr. and J. Philippe Rushton completed critical readings of this manuscript. The support of the Pioneer Fund and the Koch Charitable Foundation during the preparation of this chapter is gratefully acknowledged.

REFERENCES

- Ainslie, R.C. (1985). *The psychology of twinship*. Lincoln: University of Nebraska Press.
- Axelrod, R., & Hamilton, W.D. (1981). The evolution of cooperation. *Science*, 211, 1390–1396.
- Barash, D. (1979). *The whisperings within*. New York: Harper & Row.
- Barash, D. (1982). *Sociobiology and behavior*. New York: Elsevier.
- Bettelheim, B. (1969). *The children of the dream*. New York: Avon Books.
- Bouchard, T.J., Jr. (1984). Twins reared apart and together: What they tell us about human diversity. In S. Fox (Ed.), *The chemical and biological bases of individuality*. New York: Plenum.
- Bouchard, T.J., Jr. (1987). Diversity, development and determinism: A report on identical twins reared apart. In M. Amelang (Ed.), *Proceedings of the 1986 German Psychological Association Meetings*, Heidelberg, Germany.
- Bouchard, T.J., Jr., Lykken, D.T., Segal, N.L., & Wilcox, K.J. (1986). Development in twins reared apart: A test of the chronogenetic hypothesis. In A. Demirjian (Ed.), *Human growth: A multidisciplinary review*. London: Taylor & Francis.
- Brewster, H.H. (1957). Identical pair of poliomyelitis patients: A study of twinning. Western Divisional Meeting of the American Psychiatric Association.
- Bryan, E.M. (1983). *The nature and nurture of twins*. London: Baillière Tindall.
- Bryan, E.M. (1986). The death of a newborn twin: How can support for parents be improved? *Acta Geneticae Medicae et Gemellologiae*, 35, 115–118.
- Bulmer, M.G. (1970). *The biology of twinning in man*. Oxford: Clarendon Press.
- Burlingham, D.T. (1945). The fantasy of having a twin. *Psychoanalytic Study of the Child*, 1, 205–210.
- Burlingham, D.T. (1952). *Twins: A study of three identical pairs*. New York: International Universities Press.
- Buss, D.M. (1987). Evolutionary hypotheses and behavioral genetic methods: Hopes for a union of two disparate disciplines. *Behavioral and Brain Sciences*, 10, 20.
- Cairns, R.B. (1986). An evolutionary and developmental perspective on aggressive patterns. In C. Zahn-Waxler, E.M. Cummings & R. Iannotti (Eds.) *Altruism and aggression: Biological and social origins*. Cambridge: Cambridge University Press.
- Cairns, R.B., & Valsiner, J. (1984). Child psychology. *Annual Review of Psychology*, 35, 553–577.
- Carter-Saltzman, L. (1979). Mirror-twinning: Reflection of a genetically mediated embryological event? *Behavior Genetics*, 9, 442–443.
- Chagnon, N.A. (1979). Mate competition, favoring close kin and fissioning among the Yanomamo Indians. In N.A. Chagnon & W. Irons (Eds.), *Evolutionary biology and human social behavior: An anthropological perspective*. North Scituate, MA: Duxbury Press.

- Chagnon, N.A., & Bugos, P.E., Jr. (1979). Kin selection and conflict: An analysis of a Yanomamo ax fight. In N.A. Chagnon & W. Irons (Eds.), *Evolutionary biology and human social behavior: An anthropological perspective*. North Scituate, MA: Duxbury Press.
- Cheney, D., Seyfarth, R., & Smuts, B. (1986). Social relationships and social cognition in nonhuman primates. *Science*, 234, 1361–1366.
- Cohen, D.J., Dibble, E., Grave, J.M., & Pollin, W. (1973). Separating identical from fraternal twins. *Archives of General Psychiatry*, 7, 3–9.
- Corney, G., Seedburgh, D., Thompson, B., Campbell, D.M., MacGillivray, I. & Timlin, D. (1981). Multiple and singleton pregnancy: Differences between mothers as well as offspring. In W.E. Nance (Ed.), *Twin research 3: Twin biology and multiple pregnancy*. New York: Alan Liss, Inc.
- Crawford, C., Smith, M., & Krebs, D. (Eds.) (1987). *Sociobiology and psychology: Ideas, issues and applications*. Hillsdale, NJ: Lawrence Erlbaum.
- Dallapiccola, B., Stomeo, C., Ferranti, G., DiLecce, A., & Purpura, M. (1985). Discordant sex in one of three monozygotic triplets. *Journal of Medical Genetics*, 22, 6–11.
- Dumont-Driscoll, M., & Rose, R.J. (1983). *Testing the twin model: Is perceived similarity due to genetic identity?* Paper presented at the 13th annual Behavior Genetics Association meeting, London, England.
- Eisenberg, N. (1982). *The development of prosocial behavior*. New York: Academic Press.
- Elwood, J.M. (1985). Temporal trends in twinning. In H. Kalter (Ed.), *Issues and reviews in teratology*, 3. New York: Plenum.
- Engel, G.L. (1975). The death of a twin: Mourning and anniversary reactions. Fragments of 10 years of self-analysis. *International Journal of Psychoanalysis*, 56, 23–40.
- Essock-Vitale, S.M., & Fairbanks, L.A. (1979). Sociobiological theories of kin selection and reciprocal altruism and their relevance for psychiatry. *Journal of Nervous and Mental Disease*, 167, 23–28.
- Farber, S.L. (1981). *Identical twins reared apart: A reanalysis*. New York: Basic Books.
- Frank, R.A., & Cohen, D.J. (1980). Preadolescent development: Case studies in twins. *The Yale Journal of Biology and Medicine*, 53, 471–483.
- Freedman, D.G. (1979). *Human sociobiology*. New York: Free Press.
- Freedman, D.G. (1986). The biology of behavior with inquiries into the inheritance of temperament, stone age art, and the peopling of Australia. *Proceedings of the International Meetings of Variability and Evolution*, Rome.
- Freud, A., & Dann, S. (1951). An experiment in group upbringing. In U. Bronfenbrenner & M.A. Mahoney (Eds.), *Influences on human development*. Hinsdale, IL: The Dryden Press.
- Fuller, J. (1983a). Ethology and behavior genetics. In J. Fuller & E.C. Simmel (Eds.), *Behavior genetics: Principles and applications*. Hillsdale, NJ: Lawrence Erlbaum.
- Fuller, J. (1983b). Sociobiology and behavior genetics. In J. Fuller & E.C. Simmel (Eds.), *Behavior genetics: Principles and applications*. Hillsdale, NJ: Lawrence Erlbaum.
- Fuller, J., & Hahn, M.E. (1976). Issues in the genetics of social behavior. *Behavior Genetics*, 6, 391–406.

- Galton, F. (1875). The history of twins as a criterion of the relative powers of nature and nurture. *Journal of the Anthropological Institute*, 5, 391–406.
- Greenson, R.R. (1968). On sexual apathy in the male. *California Medicine*, 108, 275–279.
- Hamburg, D. (1977). Invited Lecture, Weizmann Institute, Rehovot, Israel.
- Hames, R. (1979). Relatedness and interaction among the Ye'Kwana: A preliminary analysis. In N.A. Chagnon & W. Irons (Eds.), *Evolutionary biology and human social behavior: An anthropological perspective*. North Scituate, MA: Duxbury Press.
- Hamilton, W.D. (1964a). The genetical evolution of social behaviour. I *Journal of Theoretical Biology*, 7, 1–16.
- Hamilton, W.D. (1964b). The genetical evolution of social behaviour. II *Journal of Theoretical Biology*, 7, 17–52.
- Hémon, D., Berger, C., & Lazar, P. (1981). Some observations concerning the decline of dizygotic twinning rate in France between 1901 and 1968. In W.E. Nance (Ed.), *Twin research 3: Twin biology and multiple pregnancy*. New York: Alan Liss, Inc.
- Hinde, R.A. (1983). *Primate social relationships*. Oxford: Blackwell Scientific Publications.
- Holmes, W.G., & Sherman, P.W. (1983). Kin recognition in animals. *American Scientist*, 71, 46–55.
- Juel-Nielsen, N. (1966). *Individual and environment: Monozygotic twins reared apart*. New York: International Universities Press.
- Kitcher, P. (1987). Précis of vaulting ambition: Sociobiology and the quest for human nature. *Behavioral and Brain Sciences*, 10, 61–71.
- Koch, H. (1966). *Twins and twin relations*. Chicago: University of Chicago Press.
- Krebs, D., & Russell, C. (1981). Role-taking and altruism: When you put yourself in the shoes of another, will they take you to their owner's aid? In J.P. Rushton & R.M. Sorrentino (Eds.), *Altruism and helping behavior: Social, personality, and developmental perspectives*. Hillsdale, NJ: Lawrence Erlbaum.
- Krupnick, J.L. (1984). Bereavement during childhood and adolescence. In M. Osterweis, F. Solomon, & M. Green (Eds.), *Bereavement: Reactions, consequences, and care*. Washington, D.C.: National Academy Press.
- Kummer, H. (1968). *Social organization of hamadryas baboons: A field study*. Chicago: University of Chicago Press.
- Kurland, J.A. (1977). Kin selection in the Japanese monkey. In F.S. Szalay (Ed.), *Contributions to primatology*, 12. Basel: S. Karger.
- Leonard, M.R. (1961). Problems in identification and ego development in twins. *Psychoanalytic Study of the Child*, 16, 300–320.
- Levy, J. (1981). Lateralization and its implications for variation in development. In E. Gollin (Ed.), *Developmental plasticity: Behavioral and biological aspects of variations in development*. New York: Academic Press.
- Lightcap, J.L., Kurland, J.A., & Burgess, R.L. (1982). Child abuse: A test of some predictions from evolutionary theory. *Ethology and Sociobiology*, 3, 61–67.
- Littlefield, C.H., & Rushton, J.P. (1986). When a child dies: The sociobiology of bereavement. *Journal of Personality and Social Psychology*, 51, 797–802.
- Loehlin, J., & Nichols, R. (1976). *Heredity, environment and personality*. Austin, Texas: University of Texas Press.

- Lykken, D.T., McGue, M.K., & Tellegen, A. (in press). Recruitment bias in twin research: The rule of two-thirds reconsidered. *Behavior Genetics*.
- MacDonald, K. (1984). An ethological-social learning theory of the development of altruism: Implications for human sociobiology. *Ethology and Sociobiology*, 5, 97–109.
- Madsen, M.C. (1967). Cooperative and competitive motivation of children in three Mexican subcultures. *Psychological Reports*, 20, 1307–1320.
- Magnus, P., Berg, K., & Bjerkdal, T. (1985). No significant difference in birth weight for offspring of birth weight discordant monozygotic females. *Early Human Development*, 12, 55–59.
- Marcus, R.F. (1986). Naturalistic observation of cooperation, helping, and sharing and their associations with empathy and affect. In C. Zahn-Waxler, E.M. Cummings, & R. Iannotti (Eds.), *Altruism and aggression: Biological and social origins*. Cambridge: Cambridge University Press.
- Merriman, C. (1924). The intellectual resemblance of twins. *Psychological Monographs*, 33, 1–58.
- Mittler, P. (1971). *The study of twins*. Harmondsworth: Penguin Books.
- Mosteller, M., Townsend, J.I., Corey, L.A., & Nance, W.E. (1981). Twinning rates in Virginia: Secular trends and the effects of maternal age and parity. In L. Gedda, P. Parisi, & W.E. Nance (Eds.), *Twin Research 3: Twin Biology and Multiple Pregnancy*. New York: Alan Liss, Inc.
- Mowrer, E. (1954). Some factors in the affectional adjustment of twins. *American Sociological Review*, 19, 468–471.
- Newman, H.H., Freeman, F.N., & Holzinger, K.J. (1937). *Twins: A study of heredity and environment*. Chicago: University of Chicago Press.
- Nichols, R.C., & Bilbro, W.C., Jr. (1966). The diagnosis of twin zygosity. *Acta Genetica Statistica Medica*, 16, 265–275.
- Nyiszli, M. *Auschwitz: A doctor's eyewitness account*. New York: Fawcett Crest.
- Nylander, P.P.S. (1975). The causation of twinning. In I. MacGillivray, P.P.S. Nylander, & G. Corney (Eds.), *Human multiple reproduction*. London: W.B. Saunders.
- Omark, D.R. (1972). *Peer group formation in young children*. Unpublished doctoral dissertation, University of Chicago.
- Osterweis, M., Solomon, F., & Green, M. (Eds.). (1984). *Bereavement: Reactions, consequences, and care*. Washington, DC: National Academy Press.
- Paluszny, M., Selzer, M.L., Vinokur, A., & Lewandowski, L. (1977). Twin relationships and depression. *American Journal of Psychiatry*, 134, 988–990.
- Panskepp, J. (1986). The psychobiology of prosocial behaviors: Separation distress, play and altruism. In C. Zahn-Waxler, E.M. Cummings, & R. Iannotti (Eds.), *Altruism and aggression: Biological and social origins*. Cambridge: Cambridge University Press.
- Parisi, P., Gatti, M., Prinzi, G., & Caperna, G. (1983). Familial incidence of twinning. *Nature*, 304, 626–628.
- Parker, N. (1964). Twins: A psychiatric study of a neurotic group. *The Medical Journal of Australia*, 2, 735–742.
- Plank, E.N. (1958). Reactions of mothers of twins in a child study group. *American Journal of Orthopsychiatry*, 28, 196–204.
- Plomin, R., & DeFries, J.C. (1980). Genetics and intelligence: Recent data. *Intelligence*, 4, 15–24.

- Plomin, R., DeFries, J.C., & McClearn, G.E. (1980). *Behavior genetics: A primer*. San Francisco: W.H. Freeman & Co.
- Plomin, R., & Willerman, L. (1975). A co-twin control study and a twin study of reflection-impulsivity in children. *Journal of Educational Psychology*, 67, 537-543.
- Pepitone, A. (1976). Toward a normative and comparative biocultural social psychology. *Journal of Personality and Social Psychology*, 34, 641-653.
- Reed, T., Norton, J.A., Jr., & Christian, J.C. (1977). Sources of information for discriminating MZ and DZ twins by dermatoglyphic patterns. *Acta Genetica Medicae et Gemellologiae*, 26, 83-86.
- Rose, R.J., Harris, E.L., Christian, J.C., & Nance, W.E. (1979). Genetic variance in nonverbal intelligence: Data from the kinships of identical twins. *Science*, 205, 1153-1155.
- Roskin, M. (1984). Emotional reactions among bereaving Israeli parents. *Israel Journal of Psychiatry and Related Sciences*, 21, 73-84.
- Rushton, J.P., Fulker, D.W., Neale, M.C., Nias, D.K.B., & Eysenck, H.J. (1986). Altruism and aggression: The heritability of individual differences. *Journal of Personality and Social Psychology*, 50, 1192-1198.
- Rushton, J.P., Littlefield, C.H., & Lumsden, C.J. (1986). Gene-culture coevolution of complex social behavior: Human altruism and mate choice. *Proceedings of the National Academy of Sciences*, 83, 7340-7343.
- Rushton, J.P., Russell, R.J.H., & Wells, P.A. (1984). Genetic similarity theory: Beyond kin selection. *Behavior Genetics*, 14, 179-183.
- Rushton, R.J.H., Rushton, J.P., & Wells, P.A. (1984). Sociobiology, personality and genetic similarity detection. In J.R. Royce & L.P. Mos (Eds.), *Annals of Theoretical Psychology*, 2, 59-65.
- Rutter, M. (1966). *Children of sick parents*. London: Oxford University Press.
- Sanders, C. (1980). A comparison of adult bereavement in the death of a spouse, child and parent. *Omega*, 10, 1979-1980.
- Scarr-Salapatek, S. (1975). Populations for the study of behavior traits. Commentary I. In K.W. Schaie, V.E. Anderson, G.E. McClearn, & J. Money (Eds.), *Developmental human behavior genetics*. Lexington, MA: D.C. Heath & Co.
- Scarr, S., & Carter-Saltzman, L. (1979). Twin method: Defense of a critical assumption. *Behavior Genetics*, 9, 527-542.
- Scott, J.P. (1977). Social genetics. *Behavior Genetics*, 7, 327-346.
- Scott, J.P. (1983). Genetics of social behavior in nonhuman animals. In J. Fuller & E.C. Simmel (Eds.), *Behavior genetics: Principles and applications*. Hillsdale, NJ: Lawrence Erlbaum.
- Segal, N.L. (1984a). Cooperation, competition, and altruism within twin sets: A reappraisal. *Ethology and Sociobiology*, 5, 163-177.
- Segal, N.L. (1984b). Zygosity testing: Laboratory and the investigator's judgment. *Acta Genetica Medicae et Gemellologiae*, 33, 515-521.
- Segal, N.L. (1985a). Monozygotic and dizygotic twins: A comparative analysis of mental ability profiles. *Child Development*, 56, 1051-1058.
- Segal, N.L. (1985b). Holocaust twins: Their special bond. *Psychology Today*, 19, 52-58.
- Segal, N.L. (1986a). Not just double trouble [Review of R.C. Ainslie, *The psychology of twinship*]. *Contemporary Psychology*, 31, 456.

- Shields, J. (1954). Personality differences and neurotic traits in normal twin schoolchildren. *Eugenics Review*, 45, 213–246.
- Shields, J. (1962). *Monozygotic twins: Brought up apart and brought up together*. London: Oxford University Press.
- Siemon, M. (1980). The separation-individuation process in adult twins. *American Journal of Psychotherapy*, 34, 387–400.
- Smith, J.A., Renshaw D.C., & Renshaw, R.H. (1968). Twins who want to be identified as twins. *Diseases of the Nervous System*, 29, 615–618.
- Sorosky, A.D., Baran, A., & Pannor, R. (1984). *The adoption triangle*. New York: Anchor Press.
- Strayer, F.F. (1981). The nature and organization of altruistic behavior among preschool children. In J.P. Rushton & R.M. Sorrentino (Eds.), *Altruism and helping behavior: Social, personality, and developmental perspectives*. Hillsdale, NJ: Lawrence Erlbaum.
- Strayer, F.F., Wareing, S., & Rushton, J.P. (1979). Social constraints on naturally occurring preschool altruism. *Ethology and Sociobiology*, 1, 3–11.
- Taylor, H.F. (1980). *The IQ game: A methodological inquiry into the heredity-environment controversy*. New Brunswick, NJ: Rutgers University Press.
- Tec, N. (1986). *When light pierced the darkness*. New York: Oxford University Press.
- Tellegen, A., Lykken, D.T., Bouchard, T.J., Jr., Wilcox, K.J., Segal, N.L., & Rich, S. (in press). Personality similarity in twins reared apart and together. *Journal of Personality and Social Psychology*.
- Thissen, D., & Gregg, B. (1980). Human assortative mating and genetic equilibrium: An evolutionary perspective. *Ethology and Sociobiology*, 1, 111–140.
- Tinbergen, N. (1963). On aims and methods of ethology. *Zeitschrift für Tierpsychologie*, 20, 410–433.
- Triseliotus, J.P. (1973). *In search of origins*. London: Kegan Paul.
- Trivers, R. (1985). *Social evolution*. Menlo Park, CA: The Benjamin/Cummings Publishing Co., Inc.
- Vandenberg, S.G. (1966). Contributions of twin research to psychology. In M. Manosevitz, G. Lindzey, & D.D. Thiessen (Eds.), *Behavioral genetics: Method and theory*. New York: Appleton-Century-Crofts.
- Vine, I. (1983). Sociobiology and social psychology—Rivalry or symbiosis? The explanation of altruism. *British Journal of Social Psychology*, 22, 1–11.
- Vogel, F., & Motulsky, A.G. (1979). *Human genetics*. New York: Springer-Verlag.
- Von Bracken, H. (1934). Mutual intimacy in twins. *Character and Personality*, 2, 293–309.
- Wilson, M.I., Daly, M., & Weghorst, S.J. (1980). Household composition and the risk of child abuse and neglect. *Journal of Biosocial Science*, 12, 333–340.
- Wilson, R.S. (1983). The Louisville Twin Study: Developmental synchronies in behavior. *Child Development*, 54, 298–316.
- Wilson, R.S. (1986). Growth and development of human twins. In F. Falkner & J.M. Tanner (Eds.), *Human Growth* (Vol. 3). New York: Plenum.
- Woodward, J. (1986, September). *The bereaved twin*. Paper presented to the Fifth International Congress on Twin Studies, Amsterdam, The Netherlands.
- Wyshak, G., Honeyman, M.S., Flannery, J.T., & Beck, A.S. (1983). Cancer in mothers of dizygotic twins. *Journal of the National Cancer Institute*, 70, 593–599.

- Yarrow, M., & Waxler, C. (1976). Dimensions and correlates of prosocial behavior in young children. *Child Development*, 47, 118–125.
- Youniss, J. (1986). Development in reciprocity through friendship. In C. Zahn-Waxler, E.M. Cummings, & R. Iannotti (Eds.), *Altruism and aggression: Biological and social origins*. Cambridge: Cambridge University Press.
- Zahn-Waxler, C., Cummings, E.M., & Iannotti, R. (Eds.). (1986). *Altruism and aggression: Biological and social origins*. Cambridge: Cambridge University Press.
- Zahn-Waxler, C. (1986). Conclusions: Lessons from the past and a look to the future. In C. Zahn-Waxler, E.M. Cummings, & R. Iannotti (Eds.), *Altruism and aggression: Biological and social origins*. Cambridge: Cambridge University Press.
- Zazzo, R. (1978). Genesis and peculiarities of the personality of twins. In W.E. Nance, G. Allen, & P. Parisi (Eds.), *Twin research (Part A). Psychology and method*. New York: Alan Liss, Inc.

7

Observations on Adolescence

GLENN E. WEISFELD and ROBIN L. BILLINGS

At puberty radical morphological changes occur. Textbooks on adolescent development have, through the years, faithfully detailed these morphological changes, but without acknowledging that these biological phenomena must necessarily possess identifiable adaptive functions. Thus the student learns various facts about the growth spurt, the appearance of hair, sexual bimaturism, etc. without ever considering the functions of these striking developments.

Since behavior interacts with morphology, this means that behavior also probably changes markedly around puberty. One example of these behavioral changes is that mental ability increases with pubertal age, so that early maturers tend to score slightly higher on intelligence tests than late maturers of the same chronological age (Tanner, 1978). Nurture also increases cross-culturally at this time, especially in girls, as does male aggressiveness (Whiting & Whiting, 1975). As the body changes, so must behavior to match it.

However, even the suggestion that some of the behavioral changes of adolescence might have an evolved basis virtually never appears in textbooks. Reading these accounts, one almost gets the impression that the sex drive itself appears because of television and "peer pressure" (other people's teenagers). Psychologists concede that hormones activate the morphological changes of puberty, but the accompanying behavioral changes are assumed almost invariably to be due to culturally induced reactions to these morphological features. The simpler possibility that pubertal hormones are influencing the behavior directly is seldom even considered (but see Simmons, Blyth, & McKinney, 1983, p. 262).

Now that sociobiology is beginning to offer plausible functional explanations for various age and sex differences in behavior, it may be time to make a fresh start at understanding human adolescence from a biological perspective. The most notable attempt to do so thus far, by Hall (1904), was based upon an incomplete understanding of evolution, by today's standards. Recently, however, several essays on primate adolescence from a modern evolutionary perspective have appeared, e.g.,

Pereira and Altmann (1985), Mitchell (1981), and Watts (1985, 1986). And Savin-Williams (1987) has now written a monograph on peer relations in human adolescents from an evolutionary viewpoint.

Our own earlier descriptions of some aspects of human adolescence from an evolutionary perspective have dealt with morphological and physiological changes, puberty rites, environmental influences on maturation, peer relations (Weisfeld, 1979), the growth spurt, sexual competition, generational conflict, solidarity, and nurturance (Weisfeld & Berger, 1983). In the present chapter we shall dwell mainly on points not addressed previously.

Maturation in Primates

Most mammals grow rapidly and steadily after birth. The velocity of the growth curve declines gradually until maturity is reached.

The higher primates show rapid growth after birth and a subsequent decline, but then a rapid growth spurt at puberty (Katchadourian, 1977). Thus they depart from the usual mammalian pattern in two ways: Growth is relatively slow during the juvenile phase, and maturity arrives relatively late (Figure 7.1).

As Tanner (1955) suggested, primates' pubertal growth spurt may not be what needs to be explained functionally, since rapid growth until maturity is typical of mammals. Rather, the slow growth of the prolonged juvenile phase in primates constitutes the anomaly.

Delayed maturation is associated with relatively large brain size (Watts, 1986), and probably allows primates to acquire the flexibility in

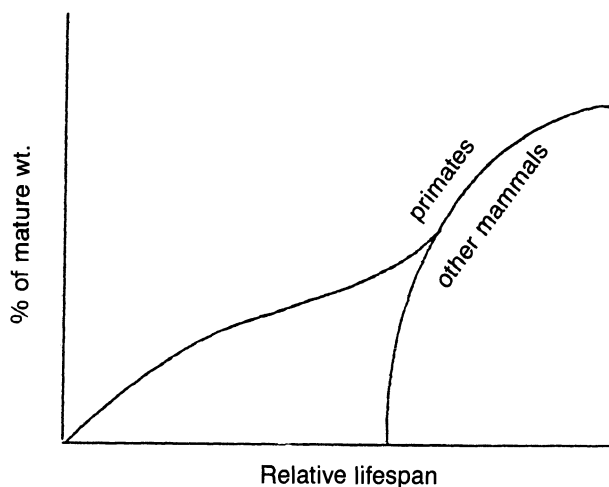


FIGURE 7.1. Weight growth over the lifespan. (Adapted from Brody, 1945.)

foraging, defensive, and social behaviors that characterize the order. In other words, the long period of immaturity reflects the primate pattern of altriciality.

The fact that juvenile primates remain small while they undergo this learning period, rather than just maturing slowly, may confer additional advantages. These may include less competition for food with adults (Tanner, 1970), especially adult males who defend other troop members in some species, and the ability to venture onto thin branches for escape and foraging.

None of these advantages of small size would seem to interfere with the concentrated learning of the juvenile stage. In fact, small size may be conducive to vigorous play, since an abundance of calories can be devoted to play if growth is not too rapid. When both growth and play are very pronounced, as in the adolescent male rhesus, caloric requirements must be enormous. As Pereira and Altmann (1985) have noted, the fact that adolescent primates of most species play less than juveniles may be related to the great need for food of the former.

Consistent with Tanner's hypothesis that slow juvenile growth constitutes the anomalous primate feature, evidence for a growth inhibiting factor has appeared. Melatonin, from the pineal, operates on the hypothalamus to suppress growth before puberty in mammals (Kolata, 1984). Perhaps this inhibiting factor acted progressively longer in ontogeny during primate evolution, resulting in a general neoteny (retention of juvenile features).

The pubertal growth spurt, then, is in a sense released once the juvenile period of apprenticeship is largely completed. What proportion of the period of immaturity consists of this juvenile phase and how much constitutes the subsequent growth spurt varies across primate species. In rhesus macaques about one third of immaturity consists of slow, juvenile growth, and two thirds is devoted to the growth spurt (Bogin, *in press*). In chimpanzees the ratio is about 1:1. In humans it is $\frac{2}{3}:\frac{1}{3}$.

One might think that these species differences reflect the amount of time necessary to gain the weight added during the growth spurt. However, the growth spurts of the two sexes are similar in duration, at least in chimpanzees and humans, despite the greater weight gain of the male. The velocity of boys' weight gain during the growth spurt exceeds girls', but the spurt lasts no longer, being about four years in both sexes.

Thus, differences in the amount of time needed to attain adult weight probably do not explain these species differences in the relative onset of the growth spurt. A more likely explanation is that different lengths of time are needed for the juvenile phase. Chimpanzees require more time to learn, absolutely and relative to brain size, than do rhesus, and children need more time than chimpanzees. What is learned during the juvenile phase presumably compensates, in the form of increased survival of offspring, for the delay in reaching the reproductive years.

Unlike weight, the greater final adult height of boys is due mainly to their longer juvenile period of growth (Tanner, 1978). Chimpanzees show similar growth dynamics, and also about the same degree of size dimorphism and bimaturism (about two years).

Only a small growth spurt is evident in the female of several primate species, including rhesus macaques and chimpanzees (Watts, 1986). This is especially true of weight gain as an index of growth. The prominent growth spurt of terrestrial male primates, insofar as it contributes to greater strength, can be understood as enhancing defense against predators and competitiveness against rival males.

Maturation in Humans

One might guess that growth in humans would be especially prolonged because of our need to learn so much. Actually, in man, the ratio of neonatal weight to female age at maturity is only average for primates (Harvey & Clutton-Brock, 1985). It appears that once a woman is large enough to bear a full-term baby, she reaches puberty just as promptly as any other primate. Of course, humans reach puberty almost twice as late as the great apes, since we have neonates almost twice as large.

That is, the delayed growth of humans can be explained with reference to our large brains and our correspondingly great need to learn, and also the large size of our neonates. In fact, several other factors are known to correlate with delayed growth in primates and other altricial mammals. These include slow postnatal development, long gestation, small litter size, and long ovulatory cycles (Watts, 1986). These traits, in turn, can be understood in terms of the stability of food supply in tropical forests, and selection operating to stabilize population size close to the carrying capacity of the habitat.

The large size of adult human females can be partly explained, then, in terms of the large size of neonates. This interpretation may help us to account for the fact that, unlike female chimpanzees, women have a rather pronounced growth spurt. Chimpanzees, while similar to us in many respects, do not have neonates nearly as large, and hence the female need not be as large to bear them. Female chimpanzees weigh about 31 kg (68 lb), males 42 kg (92 lb) (Harvey & Clutton-Brock, 1985).

Our species' long growth period does give us time for learning about child care. Bogin (in press) believes that the extensive child care that is practiced by both sexes in traditional cultures in late childhood is itself of great adaptive value. Not only does it allow future parents experience at tending young children, it also enhances their inclusive fitness when the children they care for are their kin. The parents, having shifted some of the child care to older children, can also devote more effort to the procreation and care of their next offspring. Moreover, Bogin has pointed

out, child care can often be provided while performing other duties, such as herding or gathering. At the same time, children in mixed-age groups can learn from each other while looking out for each other.

Before menarche about 16 years have elapsed for a girl to have been prepared for sexual life, in most cultures (Friedl, 1975), and she probably will not reach fertility until about 19. This period of "adolescent sterility" occurs after the beginning of puberty. It occurs in all mammals as the reproductive system becomes operational. It is not inordinately long in humans—about the same as for the great apes. Fertility peaks in humans between about 22 and 28, again for most cultures. This period begins earlier and ends later in well-nourished populations.

Adolescent sterility may allow girls a grace period for sexual experimentation with various males for as long as this period of natural contraception lasts. But this is probably a by-product of its original function of delaying fertility until the reproductive system is mature. Still, experimentation with various potential mates during this period may have been adaptive in its own right. It is typical of hunter-gatherers and common among horticulturalists (Friedl, 1975). Adolescent female chimpanzees practice coitus and then consortships before becoming fertile (Pereira & Altmann, 1985).

During the last century in the West, puberty has increasingly begun earlier and ended sooner, for both sexes, due mainly to improved nutrition. This secular trend now seems to have bottomed out, the lower biological limit having been reached. The average age of menarche is now about 13, having fallen from about 16.

American adolescents' bodies, then, are prepared for parenthood very early, but their minds seem not to have kept pace. Teenage parents are at risk to abuse their babies, and to raise them in poverty. Teenage mothers often fail to complete high school, and they are unlikely to receive significant assistance from the father. The health of these babies tend to be relatively poor mainly because of substandard prenatal practices and not because of immaturity of the mother's reproductive system (Konner and Shostak, 1986).

Parenthetically, a girl's reproductive fitness may be greater if she aborts her first fetus (Barash, 1982). Since the fetus will share genes with the mother's future offspring, even the fetus may be better off being aborted, in terms of inclusive fitness—an interesting twist on the question of fetal rights.

In some cultures, when a premarital birth occurs the grandmother often assumes primary responsibility for the baby, with other kin assisting. No great stigma attaches to the mother, and she proceeds to marry in due time. In some cultures such a demonstration of fertility actually enhances the girl's desirability as a wife.

In the U.S. an unwed mother is fortunate if she has even the part-time assistance of her mother, and she is unlikely ever to marry. It makes

some sociobiological sense for the maternal grandmother to invest in the baby, since she has low reproductive value and therefore is inclined toward aiding her kin. By the same token, the mother is near her peak reproductive value and therefore is less likely to invest in her first offspring than in later ones (Barash, 1982). This posited net flow of kin altruism from postreproductive individuals to those at their peak reproductive value may help explain the widely recognized phenomenon of the obnoxious teenager (e.g., Newman, 1985).

Girls' Puberty Rites

Wives are valued mainly as sources of parental investment, or "breeders" (Daly & Wilson, 1983). Therefore their value in the marriage market should peak along with their reproductive value. In fact, around the world girls typically marry shortly after menarche. The themes of girls' puberty rites often concern beauty and childbearing, whereas themes of death and rebirth are common for boys' (Sommer, 1978).

Initiation rites for girls serve as an occasion for displaying their virtues. Public rites are more common among those hunter-gatherer peoples in whom the women contribute substantially to subsistence (Friedl, 1975). Girls are usually initiated individually, as soon as they reach menarche and hence near their peak reproductive value. The father is often busy bargaining for a husband around this time. Thus, the girl's beauty and industry can be shown off to advantage on this occasion.

It has also been suggested that the initiation feast provides a means for the girl's father to obligate the male guests to respect her chastity, in exchange for sharing in the munificence of the celebration (Paige, 1983). This interpretation is supported by the fact that these ceremonies for girls tend to occur in societies without effective means of discouraging disrespect toward maidens, that is, in societies without either accumulated wealth and social power, or a male fraternal group to defend its members' interests. See also MacDonald (1987).

At this time genital mutilation is performed on the girls in some polygynous cultures. Infibulation (sewing the labia majora partially closed) and clitoridectomy are designed to ensure her chastity, again raising her marriage value by presumably lowering the likelihood of her husband being cuckolded (Daly & Wilson, 1983).

It is important to note that puberty rites are merely the ceremonial culmination of a period of, usually, years of intensified sex-segregated instruction preparation for adulthood (van Gennep, 1909/1960). However, girls sometimes undergo only a brief period of segregation and instruction before having their initiation ceremony.

Intergenerational Conflict

At adolescence, conflict with adults and peers increases in many species, especially over food and mates. Some parent-offspring conflict is always expected to occur. However, competition ought to be greatest between nonkin and at the maximum of reproductive value, i.e., the beginning of fertility (Emlen, 1966).

In some primate species, parents have been observed to aggress against their adolescent offspring (reviewed by Pereira & Altmann, 1985). Ruffed lemur fathers (*Varecia variegatus*) reportedly attack sons, and mothers attack daughters. Similar behavior has been seen in gibbons and siamangs. Intergenerational conflict over reproduction also takes other forms. The leading male gorilla sometimes interrupts copulation attempts by younger males, as do chimpanzees. In rhesus macaques the onset of the adult pattern of seasonal testosterone cycling was delayed in adolescent males living with adult males. In male ruffed lemurs that were housed with their families, testis size was suppressed. In adolescent female callitricids and lemurs housed with their mothers, scent marking and ovulation were diminished.

In humans, analyses of parent-adolescent dialogues have suggested that emotional distance between them increases with chronological age and, over and above that, with pubertal maturity (Steinberg, 1987a). Both of these effects were independent of pubertal timing, i.e., whether the subject was early or late to mature. These effects of chronological and pubertal age may represent cultural and biological programs for promoting independence. Commenting on human adolescence, Trivers (1985) noted that offspring at this stage are becoming much less dependent on their parents, and therefore can pursue their own reproductive success without compromising with their parents' wishes as much as before. He suggested that consequently adolescents reorganize their identities (see MacDonald, 1987). Perhaps it should be noted that it has not been demonstrated that adolescents anywhere but in the West undergo Eriksonian identity crises, apparently because elsewhere they lack the gamut of lifestyle and vocational options available here.

Steinberg and others have found that conflict between adolescent boys and their mothers at mid-puberty is a common pattern. This may reflect the reversal in dominance that occurs in all human cultures, the maturing male superseding the adult female. Consistent with this notion, Jacob (1974) reported that sons became more influential over the mother in family decisions between ages 11 and 16, but not over the father. Steinberg found that adolescent boys did not overtake their fathers in dominance, again consistent with the cross-cultural pattern. Moreover, he has now reported that intense father-son conflict predicted slow pubertal maturation (Steinberg, in press).

Finally, Magnusson, Stattin, and Allen (1985) have commented that breaking adult norms, which is more characteristic of early-maturing girls than later ones, may be viewed as attempts to establish an adult identity rather than as mere deviant behavior. Early-maturing girls tend to view themselves as more mature (Magnusson et al., 1985) and to be given more independence and responsibility (Simmons et al., 1983), so their behavior may indeed be best characterized as gravitating toward adult patterns. Moreover, Magnusson et al. suggest, it is ethically questionable to regard most of the "deviant" acts of adolescents as inappropriate or immature. Pursuits such as ignoring parents' prohibitions, staying out late, loitering in town, drinking alcohol, sexual activity, and truancy constitute, at worst, status offenses for which adults would not be disciplined. In cross-cultural perspective, adolescents who engaged in these activities would by and large be behaving normally.

Various forms of parent-adolescent difficulty are more frequent in homes without both natural parents, as one would expect from sociobiological principles. Child abuse, including sexual abuse, has been found to be most frequent when a stepparent or other nonrelative is present in the home (Daly & Wilson, 1985). Criminal arrests and running away were least frequent for adolescents in homes with both natural parents, as was deviant behavior in another study (Steinberg, 1987b).

The Daly and Wilson study also revealed that the risk to the mother of having a child who would later run away, be abused, or be arrested was related to maternal age at birth. The risk was lowest during her years of maximum fertility (19 to 36) and especially high for young mothers. This can be interpreted in terms of variability in either the incidence of congenital abnormalities or the effectiveness of maternal care.

Same-Sex Bonding

Intergenerational conflict can also help drive adolescent primates to another troop. However, other factors, positive and negative, are also thought to influence migration. These include inbreeding depression, availability of potential mates in the natal and new troop, competition and aggression encountered in the two troops, dangers confronted while migrating (Pereira & Altmann, 1985), mother-son affinity, and attraction to the subadult males of other troops (Colvin, 1983).

In most primates, pubescent males change troops more than do females. In these species, matrilineal bonds tend to be strong and enduring, e.g., rhesus macaques, savannah baboons. A daughter's dominance rank is typically adopted from the mother's. This pattern of strong female bonding seems to be related to foraging efficiency, since it is

usually seen in species with scarce or unpredictable food sources (Wrangham, 1982).

Strong male bonding is more typical of primates with abundant, dispersed food. Female migration is the rule in these species, which include hamadryas baboons, bonnet macaques, red colobus, gorillas, and chimpanzees (Greenwood, 1980; Pereira & Altmann, 1985). For example, male chimpanzees seldom transfer troops, but form kinship groups and defend their territory against intruding rivals.

It is interesting that our closest anthropoid relatives show the same patrilocal pattern as most human societies. In our species, patrilocality outnumbers matrilocality by about 4 to 1, although no strong trend exists for hunter-gatherer societies (Stephens, 1963). In a study of two patrilocal New Guinea highland societies, Wood, Smouse, and Long (1985) found that females did more dispersing, emigrating males traveled farther when they did disperse than females, male dispersal was more constrained by language differences, and both sexes migrated in response to high population density and before beginning to reproduce. Interestingly, new languages are difficult to acquire after puberty (Nash, 1978).

Mackey (1986) has claimed that the ubiquity of strong affinity between men and prepubertal boys has an evolved basis. This affinity would have promoted the transmission of expected adult male behavior to boys, through puberty rites and less formal contact. Similarly, adolescent male chimpanzees commonly accompany a particular adult male (Goodall, 1986). Our society, with its dearth of meeting places for men (especially middle-class men), relatively infrequent father-son contacts (but see Mackey, 1985), few male teachers, and delayed assumption of adult status, may render the acquisition of proper male behavior difficult for boys and may also be emotionally unsatisfying.

American women, too, have often found the social isolation of housework to be unpleasant. In most cultures women usually perform their child care, domestic work, and foraging tasks in the company of other women and children. As in the case of men's groups, women are often joined by ties of kinship (at least with affinals), and girls can learn their role by association with women.

Male bonding may have been most crucial for waging war. Collective fighting has been reported for some primates. Chimpanzees, for example, have been observed to fight with weapons. See Eibl-Eibesfeldt (1975/1979) for a thorough treatment of aggression in evolutionary, developmental, and cross-cultural perspective.

The group cohesion that an effective fighting force requires is enhanced by various social factors. These include proximity of members, sharing a common fate, similarity, and previous group successes (Turner, 1982). In most cultures the men associate together frequently, especially at work in men's lodges. As tribal leaders they must tend to be

cognizant of the group's common fate, especially when war is imminent. Puberty rites and culture-specific dress, language, and mores enhance similarity. Moreover, the well-documented conformity of early adolescents would tend to promote similarity. For details see Weisfeld and Berger (1983) and MacDonald (1987).

Lacking any punctate sign of puberty analogous to menarche, boys in most cultures begin the initiation process in a group. These boys often remain together throughout life as a functioning social unit (Sommer, 1978). It has been suggested that the harsh ordeals that boys in about two-thirds of societies undergo serve to bind the group together and also to subjugate the boys to their elders (Spindler, 1970).

Groups tend to disperse with failure and cohere with success. For example, *esprit de corps* is more difficult to maintain on a perennially losing team. Savin-Williams (1982) observed that male adolescent volleyball players on losing teams exchanged more critical remarks than did those on winning ones. These tendencies may be adaptive. Defeated warriors perhaps ought to disperse, or at least avoid future battles if possible. The opposite can be said of victors. Although seeing a comrade fall in battle often increases hostility toward the enemy, excessive losses can precipitate retreat (Rachman, 1978).

Many of the institutionalized practices of modern armies can be understood in terms of these motivational and functional concepts. Solidarity is promoted by uniforms, ritualized conformity, fraternization with comrades but not the enemy, the common fate of hazing in boot camp and undergoing actual combat, exclusion of deviants, glorification of the state and dehumanization of the enemy, and small combat units that encourage face-to-face allegiances to develop. These cohesive forces, augmented by fear of punishment and disgrace, by alcohol and other drugs to enhance aggressiveness and self-confidence, and by the prospect of rape and spoils, all conspire to overcome the natural fear of combat. Also noteworthy are the risk-taking tendencies of young males, discussed below (Daly & Wilson, 1983).

In U.S. society military recruitment techniques include appeals to patriotism and masculinity, and the promise of camaraderie, educational and employment opportunities, and foreign travel (Hoffman, 1985). Our contemporary American young people may be especially susceptible to these techniques for various reasons. They are poor at critical thinking, relative to Europeans; "illiterate" about civics (Boyer, 1983); short of alternative opportunities for male camaraderie; and threatened with unemployment. The American emphasis on sports may also be a factor, in that this is typical of warlike cultures (Eibl-Eibesfeldt, 1975/1979). The same may be said of our relative tolerance of violence (Stephens, 1963; Whiting & Whiting, 1975) and our typically authoritarian, militant parental style (e.g., Lesser & Kandel, 1969). Incidentally, textbooks on adolescence seldom mention military service

and its psychological consequences. Little independent research seems to have been conducted on military life (but see Mazur, Mazur, & Keating, 1984).

Control of Maturation Rate

As implied above, experiential factors such as nutrition and health can alter the speed of maturation in both sexes. This refers to both prepubertal and pubertal maturation. The chronically elevated corticosteroid levels of prolonged stress can lower production of gonadotrophins and growth hormone, resulting in delayed or retarded maturation.

The reproductive success of female mammals is closely tied to number of reproductive years, because of their relatively slow rate of producing offspring. Therefore selection should have favored compensatory resistance to the retarding effects of environmental stressors on pubertal onset. Indeed, stressors such as atomic radiation in Japan and undernutrition do retard puberty less in females than in males, in studies on various mammals including humans (Tanner, 1978).

On the other hand, a female whose maturation is incomplete ought not to begin reproductive life. If a pregnant female is not large and healthy enough to bear viable young, she may even die at birth, or be severely weakened by gestation and lactation.

Therefore selection would have favored females whose rate of maturation was highly sensitive to her bodily condition. Menarche is, in fact, very closely tied to growth milestones in height, skeletal age, body fat (crucial to nourishing the fetus and infant), and weight (Frisch, 1983; Pereira & Altmann, 1985). A female that succeeded in feeding well will have matured early and will have high reproductive fitness. Nevertheless, the time needed for complete maturation would have imposed a strict lower limit on pubertal onset even under ideal environmental conditions.

For males the onset of reproduction is controlled mainly by sexual opportunities (Pereira & Altmann, 1985). These in turn depend largely on the ability to compete successfully against other males for dominance, in many primate species. Successful competitors tend to be large and strong, i.e., in good, mature bodily condition.

If a male is fertile before he is fully grown, no catastrophe is likely to result, as may occur with immature females. He may have few sexual opportunities until he is larger and stronger, but any fertilizations that he does achieve will not jeopardize his future reproductive fitness in any obvious way. Thus, for males, pubertal onset is probably not as closely tied to bodily condition as it is for females. This may help to explain the fact that, whereas girls are almost fully grown when they become fertile, boys are still growing (Bogin, *in press*).

Because reproductive success in males depends more on bodily condition than on number of reproductive years, they can be expected to delay puberty under unfavorable circumstances, i.e., when their bodily condition is poor. This is why males of many species reach puberty after the females: the males sacrifice some of their reproductive years in favor of enhanced breeding success at the peak of their powers, when they may increase their reproductive success greatly over a brief period.

On the other hand, a male in good bodily condition as a juvenile ought to exploit that advantage by reaching puberty early, even if the benefits of doing so are not as great as they are for females. Male *Anolis garmani* lizards that grow fast when small tend to grow fast when large (Trivers, 1985). This also seems to occur in our species: early-maturing young boys tend to become early-maturing adolescents (Tanner, 1978).

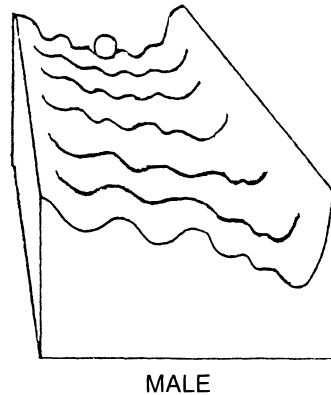
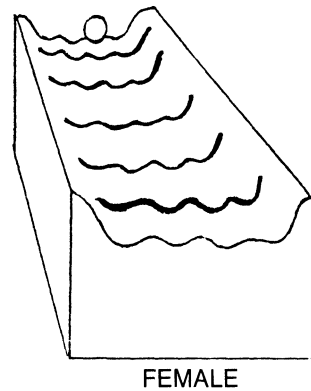
Selection, then, seems to have favored somewhat different maturational patterns for the sexes. Females typically maximize their reproductive years; they tend to mature two years earlier than males in our species. In females selection has resulted in narrow control of pubertal onset. Presumably, strong selection for the ideal onset probably occurred, along with resistance to the retarding effect of environmental extremes. At the same time, sensitivity to minor variations in environmental factors would have been favored. Males, on the other hand, would have undergone strong selection for fitness-enhancing traits such as fighting ability. Pubertal onset would have been related to these physiognomic factors, since good fighters would benefit from early maturity. Sensitivity to minor environmental influences would be rather slight, but vulnerability to environmental extremes would, as usual, typify males. Figure 7.2 represents an attempt to depict these hypothesized sex differences in terms of Waddington's (1966) canalization model.

Maturation Rate and Dominance in Boys

Boys who reach puberty early tend to be viewed more favorably by peers and adults than are later maturers (e.g., Jones & Bayley, 1950). In ethological terms, early-puberty boys are dominant. Developmental psychologists usually claim that these boys' dominance results from having promptly attained the culturally ideal bodily form for adult males in our society.

However, there are several problems with this explanation. Various pieces of evidence suggest that *early puberty* is not crucial to these boys' dominance. For example, we found that dominant adolescent boys had been dominant throughout development, starting from 6 years of age (Weisfeld, Muczenski, Weisfeld, & Omark, 1987). Just as mating success in male red deer at 6 years of age can be predicted on the basis of antler

FIGURE 7.2. Depiction of hypothesized sex differences in control of pubertal onset. Development is represented by rolling marble, whose initial position is genetically determined and whose subsequent course is guided by gene-environment interaction. Early maturity paths are on left.



size at 16 months (Trivers, 1985), so could boys' dominance in high school be predicted from dominance data that were gathered about nine years earlier ($r = .71$). Thus pubertal events probably were not pivotal in determining adolescent dominance. Similarly, dominance in African hunting dogs is probably established within the first four months of life; few reversals occur among adults (Triver, 1985).

Perhaps these dominant boys have been *early maturers throughout development*, and this is what makes them appealing to their peers. In fact, as we have mentioned, dominant boys do tend to have been early maturers throughout development.

However, it seems likely that *bodily form* (or condition) is more salient to dominance than is maturity, being more directly tied to fighting ability and more discernible by peers, especially after puberty. A great deal of cross-national research indicates that throughout development

strong, athletic boys are dominant, popular leaders (reviewed in Weisfeld et al., 1987). Moreover, the physiognomic traits that seem to enhance athletic ability appear to be highly heritable (Klissouras, 1984), so that bodily condition in males as it affects dominance seems also to be heritable, as expected. Thus, a cluster of stable, highly heritable traits seem to enhance dominance in boys, including early maturation, strength, and athletic ability (Tanner, 1978). These traits tend to be correlated because, as we have maintained above, males in good bodily condition ought to exploit this advantage by reaching reproductive age early. However, dominance and reproductive success are based more directly on bodily condition than on maturity. Therefore, the available data on maturation in boys seem to be consistent with our model (Figure 7.2).

Thus, it appears that bodily condition—being strong and athletic—enhances dominance in boys, as it does in many other species. This makes sense given the presumed importance of strength and athletic ability to the prehistorically crucial male pursuits of hunting, defense, and combat with rivals. Furthermore, these strong, dominant males would be expected to be reproductively successful, as further discussed below.

The dominance hierarchy for a cohort of boys seems to be stabilized by about 6 years of age. Why so early? Perhaps there are important resources being sought then, such as opportunities to practice leadership, direct play, participate actively, and escape the fear of defeat, exclusion, or ridicule.¹ Cognitive readiness to conceptualize linear dominance hierarchies may impose a lower age limit on the development of this behavior (Omark & Edelman, 1976).

At puberty competitiveness probably rises again because of another increase in the value of resources sought, especially food and mates, and possibly because of differentials in strength brought about by differentials in pubertal onset (Neill, 1985). If the dominance hierarchy among peers has been largely determined by then, however, this competitiveness can be directed mainly toward older adults.

Boys' Maturation Rate and Attractiveness

Boys with good genes for reproductive fitness tend to mature early. They are athletic, possessing the traits that presumably made their Pleistocene male ancestors good hunters, warriors, and progenitors.

¹Fear, defeat, and lowered dominance rank can retard maturation in various mammals of both sexes (e.g., Barash, 1982), probably by raising corticosteroids and lowering gonadotrophins (Bernstein, Gordon, & Rose, 1983). Also, in female mice pubertal maturation can be delayed by the presence of adult females, and accelerated by adult males (Lombardi & Vandenberg, 1977; Massey & Vandenberg, 1980). These effects are interesting to analyze in terms of the benefits to each individual.

These athletic boys tend to be attractive to both sexes (Weisfeld et al., 1987). Girls seek them as courtship partners and eventually as husbands. Boys seek them as leaders and friends. Having been deferred to throughout their lives, these dominant boys have had experience as leaders. They tend to be socially skilled, above and beyond their charismatic control of others' attention. These cumulated positive social experiences render them relaxed, sociable, and high in self-esteem and self-confidence. These benefits seem to persist at least 20 years after adolescence, if not permanently. It has been suggested that early-maturing boys have longer to wait before their sexual frustrations begin to be relieved (Tanner, 1978), but they are more sexually active, and begin at a younger age, than their late-maturing peers.

Do females really care that much about boys' appearance? Some anthropologists have claimed that a man's appearance is not as important as a woman's (Ford & Beach, 1951). However, Rosenblatt (1974) has suggested that this conclusion is due to the preponderance of male ethnographers asking these delicate questions. One indication that the attractiveness of both sexes is important in mate selection is the finding that U.S. spouses closely resemble each other in attractiveness as rated by others (Cook & McHenry, 1978).

The importance of male attractiveness may also have been obscured by the fact that men tend to be the sexual initiators in the vast majority of cultures (Stephens, 1963). However, the woman often takes the initiative covertly (Eibl-Eibesfeldt, 1970–1971; Moore, 1985), and regulates the encounter once it begins.

The importance of appearance to both sexes may have been underestimated because of a prevailing myth about its complete cultural relativity. We are taught that "beauty is in the eye of the beholder." This may be true, but it got there through natural selection, which would have favored individuals who were attracted to fit potential mates. That this is true in our species is suggested by the very high correlations between attractiveness and athletic ability in adolescent boys (Weisfeld, Omark, & Cronin, 1980). Furthermore, evidence for cross-cultural standards of pulchritude is now being gathered (Cunningham, 1984; Keating, 1985). Other investigators are beginning to define attractive features anthropometrically (Horvath, 1981).

It may be that men are selected more on the basis of wealth than looks, whereas women are selected mainly for their youth and beauty. However, women doubtless are more selective in general than men, so that even women's second criterion may be more important than men's first. During high school, girls seem to care almost exclusively about a boy's appearance and athletic ability, especially when one considers their actual choices of boys rather than the criteria they state they employ. In college, when presumably women are thinking more about marriage than casual dating, a man's earning power becomes a consideration—along with his appearance (Weisfeld et al., 1987).

Cross-culturally, one would expect the same developmental pattern. In this context it is interesting that in cultures with large disparities of wealth, marriages tend to be arranged by parents. Being concerned about the significant economic consequences of a marriage, parents employ various forms of sexual restrictiveness to prevent young people from forming amorous bonds on their own (Daly & Wilson, 1983). Similarly, within a particular society the poorer classes are less restrictive of their children's sexuality than the wealthier classes; the literal meaning of *vulgar* is *lower class*.

The epidemic of unwed motherhood today in the U.S. underclass may result largely from a shortage of young males prepared to provide much parental investment. In highly stratified societies such as the U.S. there tend to be numerous males with so few resources that they cannot compete effectively for wives. Unlike our own society, however, these highly stratified cultures usually allow polygyny, so that few women are left unmarried. In the absence of a marriage prospect, an underclass American girl may select a lover primarily on the basis of appearance.

Another consequence of the relatively numerous single mothers in our society is that no father is present to guard his daughters' chastity (MacDonald, 1987). Girls without a father at home tend to be more sexually active than girls living in any other arrangement, for both blacks and whites (Cook & McHenry, 1978). This may help to explain why girls who were conceived out of wedlock are very likely to become unwed mothers themselves. The absence of a male protector also renders these girls more vulnerable to rape (Thornhill & Thornhill, 1983). Therefore they may seek a lover who appears strong and tough enough to protect them. Boys, in turn, will aspire to be tough (Weisfeld & Feldman, 1982).

Girls' Maturation Rate and Attractiveness

Unlike the case of boys, early maturity confers no general social benefit on adolescent girls (Faust, 1960; Simmons et al., 1983). As the first girls in a class reach menarche, they tend to be rather unpopular with other girls. Over all of adolescence, they are relatively dissatisfied with their bodies, and do less well academically. However, they are popular with boys all along, are granted more independence by parents, and later are popular with other girls.

One explanation for this pattern is that the first girls to reach puberty are asynchronous with their peers and therefore feel awkward (Jones & Mussen, 1958). This makes sense in that these girls, being around 11 years old, are still in the throes of the "age of conformity" and presumably wish not to appear unusual. However, later on in adolescence these early-maturing girls, rather than average maturers, will

enjoy certain advantages. Moreover, it is the first *boys* to mature, rather than average maturers, who are advantaged.

True, only girls reach puberty before their age peers of both sexes, whereas early boys are close to the mean for both sexes. However, it seems unlikely that adolescents make these developmental comparisons irrespective of gender, given the divergent morphological patterns of the two sexes. Even if they did, one would expect that *late* girls would be most advantaged, whereas the opposite is true throughout most of the adolescent years.

Another common socialization explanation (Tobin-Richards, Boxer, & Petersen, 1983) is that the social advantages that early-puberty boys gain are due to their having first attained the ideal male body form. But why are early girls not similarly valued for exhibiting the mature female form? Some commentators (e.g., Tobin-Richards et al., 1983) reply that female curvaceousness is too threatening for our sexually repressive society. If this were true, then *late* maturers of *both* sexes would be highest in prestige, whereas the opposite is true in the main—especially for boys, the gender notorious for its unbridled libido.

Some alternative explanations are possible for the weak and inconsistent association in girls between early maturity and social benefits. First, different types of social effects seem to be operating for girls, and at different times. Although initially less popular with *girls*, early-puberty girls are more popular with *boys* all along—for obvious biological reasons. Their emerging sexuality may initially embarrass these girls, but their earlier and greater dating experience may ultimately contribute to their eventual greater prestige among other girls. Similarly, early-maturing girls tend to be less accomplished in terms of *adult* perceptions. Possibly partly because they are less achievement-motivated and more romantic (Jones & Mussen, 1958), early girls do less well academically, have more behavior problems (Simmons et al., 1983), and experience less school leadership (Jones & Mussen, 1958).

But the main reason for the weak association between pubertal maturity and prestige in girls may be something quite different. For girls as for boys, physical attractiveness seems to influence popularity very strongly (Adams, 1977). For boys, early maturity and attractiveness are closely associated (Jones & Bayley, 1950). However, early girls are not especially attractive (Elder, 1968), nor are they as satisfied with their bodies as are late- and average-maturing girls (Tobin-Richards et al., 1983). Perhaps in girls, maturation and attractiveness—and hence prestige—are not closely tied together. This, in turn, may be because maturation in females is less highly heritable than attractiveness, as suggested above. It also seems to be due to the fact that early-puberty girls tend to be short and chubby, and hence different from the current American cultural ideal (Tobin-Richards et al., 1983).

Courtship

As is the case for boys, adolescent girls who are popular tend to be attractive. This makes sound biological sense if feminine attractiveness connotes high fertility and good genes. Popular adolescent girls also tend to be rated by peers as well groomed and fashionably dressed (Allen & Eicher, 1973; Weisfeld, Bloch, & Ivers, 1984). High school girls' attention to clothes and cosmetics may be viewed as a form of female competition. The close attention that males pay to adornment in many other cultures, especially polygynous ones, seems to reflect the fact that male dress typically connotes social rank, rather than marital status as in females (Low, 1979).

Being the more selective sex, females ought also to evaluate males assiduously. Teenage girls, at least in our society, seem to devote a great deal of time to assessing boys, and to determining who is dating whom. This information would seem to be helpful for refining one's judgment of boys' appeal and also for identifying eligibles. Similarly, the romance novels that girls often avidly read have been referred to as the equivalent of pornography for males (Stoller, 1970).

When a girl sets her sights on a particular boy, she usually tries to attract his interest in a subtle manner. Presumably she wishes not to appear forward, i.e., promiscuous. Hypergamous women tend to be sexually restrained, as well as attractive and well groomed (Elder, 1968). Daly and Wilson (1983) likewise stress the apparent importance of a woman's chastity in many cultures.

Males, on the other hand, usually wish to advertise their sexual activity. Male bragging sessions are reportedly universal (Freedman, 1967). Boys' tendency to tell the world is indicated by a report that most of the males told more than four of their friends about their first sexual experience, but only 20% of the girls did (Carns, 1973).

Boys also exchange strategic information, or at least used to. Kirkendall (1961) interviewed college men and found that they discussed who was available and willing, and the art of seduction. In today's enlightened age, no doubt this finding is of historical interest only.

The intrepid Kirkendall also found that, when discussing their first sexual experience, girls sought mainly to assuage their guilt. This is especially understandable in a climate of concealment of sexual activity. Boys, on the other hand, would be expected to distort the truth somewhat, given the exaggerated accounts bruited about by other males. These two, opposite biases in self-reports of sexual activity doubtless have plagued researchers since the time of Kinsey (Coleman, 1980).

Girls may be especially inclined to detect boys who exhibit false dominance cues. Boys who acted dominantly were rated higher by girls than those boys who were just as successful at puzzle solving but were less assertive. However, boys who acted dominantly despite incompetence

were rated lower by girls than those who were incompetent and not assertive (Touhey, 1974). Perhaps girls are equally wary of other brands of deception by males.

Another indication of the importance of male dominance to sexual success comes from an experiment by Arkowitz, Lichtenstein, McGovern, & Hines (1975). Men who dated a lot responded quickly and assertively when they listened to a taped stimulus—a woman's mild rebuff. For example, when the woman refused an invitation to dance, saying "I'm not a good dancer," a successful man might reply, "Neither am I; let's go outside." A typical response by a man who got fewer dates was, "Oh, er." Being able to keep one's composure under such circumstances might reflect lifelong self-confidence, which is founded largely on possessing desirable physiognomic traits. This is not to deny the obvious fact that snappy answers can be practiced to good effect. But sooner or later the schlemiel can be expected to betray himself.

It is possible that a female sometimes tests males by stimulating competitions between them or by seeing if she can intimidate them. In various species the female will not mate with a male that she can dominate. In this context it is interesting that men who had younger sisters and married women with older brothers were happier than men with older sisters who married women with younger brothers (Kemper, 1966). The author interpreted this result in terms of dominance. For further discussion of male-female competition and its effects on courtship, see Weisfeld, Weisfeld, and Callaghan (1982).

Males tend to take more chances than females. This is mainly because selection has favored a male that succeeded in fertilizing multiple females even at the eventual expense of his life. The violent behavior of many American underclass young men may actually be highly rational, given the existing benefits, costs, and alternatives (Wilson & Daly, 1985). The competitive strategy of crime and violence may be optimal for these marginal youths, who also tend to receive little parental investment (Alexander, 1979).

Males engage in another type of risky behavior that is often overlooked. This too may be due ultimately to males' greater competitiveness. They respond more to competitive challenges than do females. For example, they are more likely to select a game of skill than a game of chance, relative to females (Deaux, White, & Farris, 1975). Even in early childhood, boys overrate their abilities more than girls do (Omark & Edelman, 1976). This sex difference continues into adulthood. Males may overrate themselves because this encourages them to issue and to accept challenges against otherwise daunting opponents. They deceive themselves into believing they will be victorious. Their resulting self-confidence, unwarranted in objective terms, may sometimes provide the margin of victory.

Nurturance and Competitiveness

Prenatal (inductive) sex hormone levels seem capable of influencing later nurturant, amatory, and competitive behavior in human females (Hoyenga & Hoyenga, 1979). Subsequent research has confirmed Money & Ehrhardt's (1972) original conclusion along these lines.

Since girls tend to reach puberty before boys, we may tentatively characterize early-maturing girls as more feminized than late maturers. For example, fetally masculinized girls subsequently reach puberty relatively late, as well as being less nurturant and more career-oriented. The case of boys is more complicated since dominant, masculine boys tend to mature early; however, homosexual boys tend to mature early too.

The notion that early-maturing girls tend to be more feminine is supported by various findings. They begin steady dating and sexual activity earlier, value childbearing more, and consider themselves more romantic than late-maturing girls (Magnussen et al., 1985). These results are all consistent with reports on fetally masculinized girls.

Moreover, early-maturing girls complete fewer years of education (Magnussen et al., 1985), earn lower grades, and score lower on achievement tests (Simmons, Blyth, Van Cleave, & Bush, 1979), despite having IQs slightly higher than those of late maturers. Evidently, early-maturing girls in Sweden and the U.S. are less competitive academically than late maturers. These results, too, are consistent with research on hormonal influences on competitive behavior. For example, fetally masculinized girls rated having a career as more important than did controls (Baker, 1980). And women in traditionally masculine occupations had higher levels of some androgens than did women in traditionally feminine positions (Purifoy & Koopmans, 1979).

Early maturity can influence girls' nurturance, amorousness, and competitiveness in at least two ways. Developmentalists (e.g., Magnusson et al., 1985) usually assume that early maturity produces bodily changes that trigger reactions in others; these reactions influence the early maturer's behavior and self-concept. Doubtless this sequence occurs in the case of many behaviors. For example, Magnusson et al. (1985) have shown that early-maturing Swedish girls violate social norms more than late maturers only if they have older friends. On the basis of further research, these authors concluded that older friends were perceived as more tolerant of norm violations by early maturers. Apparently, early maturity interacts with the behavior of older friends to increase norm violations. This sequence is illustrated by pathway *a* in Figure 7.3.

In the case of the high level of nurturant, competitive, and amatory behavior of early-maturing girls, however, a simpler explanation may also apply. The hormonal effects of early maturity can influence

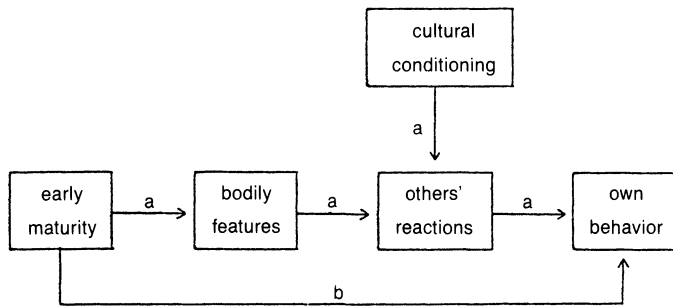


FIGURE 7.3. Alternative explanations for effects of early maturity on behavior.

behavior directly (pathway *b*). The consistent failure to consider this more parsimonious possibility may reflect a general resistance by social scientists to the notion that sex hormones can influence human behavior directly, as opposed to indirectly through others' culturally conditioned reactions to pubertal features. Even the notion that some of these reactions to bodily features may have an evolved basis is usually anathema (but see Steinberg, 1986). Yet the existence of effects of sex hormones on human social behavior is implied by a growing body of endocrinological research.

Steinberg (in press) deserves mention for considering the possibility of reciprocal influences of pubertal maturation and parent-adolescent behavioral dynamics. He has even proposed specific hormonal and evolutionary explanations for some of these possible effects.

Conclusion

Much of the early ethological research on humans dealt with infancy. It was as though infants, lacking language, might retain some evolved behavioral tendencies. But genes and experience interact to cause all behavior throughout the lifespan, not just in infancy. This is indicated by the high heritability of many adult traits, and by the stability of many others from early infancy to adolescence (Scarr, 1969). Moreover, in theory each universal stage of life must be heralded by essential biological adjustments that affect perception, morphology, physiology, cognition, emotions, and motivation.

Of all the stages subsequent to weaning, none is more prominent than puberty. The body undergoes far more than a series of minor midcourse corrections. A metamorphosis occurs.

It is time to apply biological principles to the study of adolescent behavior. This is especially true in light of the many pressing social

problems that involve adolescents and young adults. We need to develop an ethogram of normal human adolescence, so that we can understand variations on this general pattern. More than a cross-cultural and historical perspective is necessary for this. We need a cross-species perspective also, so that we can appreciate the evolutionary functions of behaviors that perplex us.

It has been said that he who understands history has been alive since the dawn of civilization. How much wiser, then, must be he who can also look back into prehistory, and see what came long before that.

Acknowledgments. The helpful comments of Sean R. St. J. Neill and Laurence Stettner are greatly appreciated.

REFERENCES

- Adams, G.R. (1977). Physical attractiveness research: Toward a developmental social psychology of beauty. *Human Development*, 20, 217-239.
- Alexander, R.D. (1979). *Darwinism and human affairs*. Seattle: University of Washington Press.
- Allen, C.D., & Eicher, J.B. (1973). Adolescent girls' acceptance and rejection based on appearances. *Adolescence*, 8, 125-138.
- Arkowitz, H., Lichtenstein, E., McGovern, K., & Hines, P. (1975). The behavioural assessment of social competence in males. *Behaviour Therapy*, 6, 3-13.
- Baker, S.W. (1980). Psychosexual differentiation in the human. *Biology of Reproduction*, 22, 61-72.
- Barash, D.P. (1982). *Sociobiology and behavior*. New York: Elsevier Science.
- Bernstein, I.S., Gordon, T.P., & Rose, R.M. (1983). The interaction of hormones, behavior, and social context in nonhuman primates. In B.B. Svare (Ed.), *Hormones and aggressive behavior*. New York: Plenum.
- Bogin, B. (in press). *Patterns of human growth*. Cambridge University Press.
- Boyer, E.L. (1983). *High school: A report on secondary education in America*. New York: Harper and Row.
- Brody, S. (1945). *Bioenergetics and growth*. New York: Reinhold.
- Carns, D.E. (1973). Talking about sex: Notes on first coitus and the double standard. *Journal of Marriage and the Family*, 35, 677-688.
- Coleman, J.C. (1980). *The nature of adolescence*. New York: Methuen.
- Colvin, N. (1983). Influences of the social situation on male emigration. In R.A. Hinde (Ed.), *Primate social relationships*. Oxford: Blackwell.
- Cook, M., & McHenry, R. (1978). *Sexual attraction*. New York: Pergamon.
- Cunningham, M.R. (1984, August). *Beauty in the eye of the beheld: The sociobiological basis of female facial attractiveness*. Paper presented at the Animal Behavior Society convention, Cheney, WA.
- Daly, M., & Wilson, M. (1983). *Sex, evolution, and behavior*. Boston: PWS Publishers.
- Daly, M., & Wilson, M. (1985). Child abuse and other risks of not living with both parents. *Ethology and Sociobiology*, 6, 197-210.

- Deaux, K., White, L., & Farris, E. (1975). Skill versus luck: Field and laboratory studies of male and female preferences. *Journal of Personality and Social Psychology*, 32, 629-636.
- Eibl-Eibesfeldt, I. (1970/1971). *Love and hate: The natural history of behavior patterns*. New York: Holt, Rinehart, & Winston.
- Eibl-Eibesfeldt, I. (1975/1979). *The biology of peace and war: Men, animals, and aggression*. New York: Viking.
- Elder, G.H., Jr. (1968). *Adolescent socialization and personality development*. Chicago: Rand McNally & Co.
- Emlen, J.M. (1966). Natural selection and human behavior. *Journal of Theoretical Biology*, 12, 410-418.
- Faust, M. (1960). Developmental maturity as a determinant of prestige in adolescent girls. *Child Development*, 31, 173-184.
- Ford, C.S., & Beach, F.A. (1951). *Patterns of sexual behavior*. New York: Harper & Bros.
- Freedman, D.G. (1967). A biological view of man's social behavior. In W. Etkin (Ed.), *Social behavior from fish to man* (pp. 152-188). Chicago: University of Chicago Press.
- Friedl, E. (1975). *Women and men: An anthropologist's view*. New York: Holt, Rinehart & Winston.
- Frisch, R.E. (1983). Fatness, puberty, and fertility. In J. Brooks-Gunn & A.C. Petersen (Eds.), *Girls at puberty: Biological and psychosocial perspectives* (pp. 29-49). New York: Plenum.
- Goodall, J. (1986). *The chimpanzees of Gombe*. Cambridge, MA: Harvard University Press.
- Greenwood, P.J. (1980). Mating systems, philopatry, and dispersal in birds and mammals. *Animal Behaviour*, 28, 1140-1162.
- Hall, G.S. (1904). *Adolescence: Its psychology and its relations to physiology, anthropology, sociology, sex, crime, religion, and education* (Vol. 1). Englewood Cliffs, NJ: Prentice-Hall.
- Harvey, P.H., & Clutton-Brock, T.H. (1985). Life history variation in primates. *Evolution*, 39, 559-581.
- Hoffman, C. (1985, September). Playing soldier: ROTC goes to high school. *The Progressive*, pp. 27-28.
- Horvath, T. (1981). Physical attractiveness: The influence of selected torso parameters. *Archives of Sexual Behavior*, 10, 21-24.
- Hoyenga, K.G., & Hoyenga, K.T. (1979). *The question of sex differences: Psychological, cultural, and biological issues*. Boston: Little, Brown.
- Jacob, T. (1974). Patterns of family conflict and dominance as a function of age and social class. *Developmental Psychology*, 10, 1-12.
- Jones, M.C., & Bayley, N. (1950). Physical maturing among boys as related to behavior. *Journal of Educational Psychology*, 41, 129-148.
- Jones, M.C., & Mussen, P.H. (1958). Self-conceptions, motivations, and interpersonal attitudes of early- and late-maturing girls. *Child Development*, 29, 492-501.
- Katchadourian, H. (1977). *The biology of adolescence*. San Francisco: Freeman.
- Keating, C.F. (1985). Human dominance signals: The primate in us. In S.L. Ellyson & J.F. Dovidio (Eds.), *Power, dominance, and nonverbal behavior*. New York: Springer-Verlag.

- Kemper, T.D. (1966). Mate selection and marital satisfaction according to sibling type of husband and wife. *Journal of Marriage and the Family*, 28, 346-349.
- Kirkendall, L.A. (1961). *Premarital intercourse and interpersonal relations*. New York: Julian Press.
- Klissouras, V. (1984). Factors affecting physical performance with reference to heredity. In Borms et al. (Eds.), *Human growth and development*. New York: Plenum.
- Kolata, G. (1984). Puberty mystery solved. *Science*, 223, 272.
- Konner, M., & Shostak, M. (1986). Adolescent pregnancy and childbearing: an anthropological perspective. In J.B. Lancaster & B.A. Hamburg (Eds.), *School-Age Pregnancy and Parenthood: Biosocial Dimensions*. New York: Aldine de Gruyter.
- Lesser, G.S., & Kandel, D. (1969). Parent-adolescent relationships and adolescent independence in the United States and Denmark. *Journal of Marriage and the Family*, 31, 347-358.
- Lombardi, J.R., and Vandenberg, J.G. (1977). Pheromonally induced sexual maturation in females: Regulation by the social environment of the male. *Science*, 196, 545-546.
- Low, B.S. (1979). Sexual selection and human ornamentation. In N. Chagnon & W. Irons (Eds.), *Evolutionary biology and human social behavior: An anthropological perspective* (pp. 462-487). North Scituate, MA: Duxbury Press.
- MacDonald, K. (1987). Biological and psychosocial interactions in early adolescence: A sociobiological perspective. In M. Lerner & T.T. Foch (Eds.), *Biological and psychosocial interactions in early adolescence: A life span perspective*. Hillsdale, NJ: Lawrence Erlbaum.
- Mackey, W.C. (1985). A cross-cultural perspective on perceptions of paternalistic deficiencies in the United States: The myth of the derelict daddy. *Sex Roles*, 12, 509-533.
- Mackey, W.C. (1986). A facet of the man-child bond: The teeter-totter effect. *Ethology and Sociobiology*, 7, 117-134.
- Magnusson, D., Stattin, H., & Allen, V.L. (1985). Differential maturation among girls and its relation to social adjustment: A longitudinal perspective. *Reports from the Department of Psychology*, University of Stockholm, Supplement 62.
- Massey, A., & Vandenberg, J.G. (1980). Puberty delay by a urinary cue from female house mice in feral populations. *Science*, 209, 821-822.
- Mazur, A., Mazur, J., & Keating, C. (1984). Military rank attainment of a West Point class: Effects of cadets' physical features. *American Journal of Sociology*, 90, 125-150.
- Mitchell, G. (1981). *Human sex differences: A primatologist's perspective*. New York: Van Nostrand Reinhold.
- Money, J., & Ehrhardt, A.A. (1972). *Man and woman, boy and girl*. Baltimore: John Hopkins University Press.
- Moore, M.M. (1985). Nonverbal courtship patterns in women: Context and consequences. *Ethology and Sociobiology*, 6, 237-247.
- Nash, J. (1978). *Developmental psychology: A psychobiological approach*. Englewood Cliffs, NJ: Prentice-Hall.
- Neill, S.R. (1985). Rough-and-tumble and aggression in school children: Serious play? *Animal Behaviour*, 33, 1380-1382.

- Newman, J. (1985). Adolescents: Why they can be so obnoxious. *Adolescence*, 20, 634-646.
- Omark, D.K., & Edelman, M.S. (1976). The development of attention structures in young children. In M.R.A. Chance & R.R. Larsen (Eds.), *The social structure of attention* (pp. 119-151). London: Wiley.
- Paige, K.E. (1983). A bargaining theory of menarchial responses in preindustrial cultures. In J. Brooks-Gunn & A.C. Petersen (Eds.), *Girls at puberty: Biological and psychosocial perspectives* (pp. 301-322). New York: Plenum Press.
- Pereira, M.E., & Altmann, J. (1985). Development of social behavior in free-living nonhuman primates. In E.S. Watts (Ed.), *Nonhuman primate models for human growth and development* (pp. 217-309). New York: Alan Liss.
- Purifoy, F.E., & Koopmans, L.H. (1979). Androstenedione, testosterone, and free testosterone concentration in women of various occupations. *Social Biology*, 26, 179-188.
- Rachman, S.J. (1978). *Fear and courage*. San Francisco: Freeman.
- Rosenblatt, P.C. (1974). Cross-cultural perspective on attraction. In T.L. Huston (Ed.), *Foundations of interpersonal attraction* (pp. 79-95). New York: Academic.
- Savin-Williams, R.C. (1982). A field study of adolescent social interactions: Developmental and contextual influences. *Journal of Social Psychology*, 117, 203-209.
- Savin-Williams, R.C. (1987). *Adolescence: An Ethological Perspective*. New York: Springer-Verlag.
- Scarr, S. (1969). Social introversion-extraversion as a heritable response. *Child Development*, 40, 823-832.
- Simmons, R.G., Blyth, D.A., & McKinney, K.L. (1983). The social and psychological effects of puberty on white females. In J. Brooks-Gunn & A.C. Petersen (Eds.), *Girls at puberty: Biological and psychosocial perspectives*. New York: Plenum.
- Simmons, R.G., Blyth, D.A., VanCleave, E.F., & Bush, D.M. (1979). Entry into early adolescence: The impact of school structure, puberty, and early dating on self-esteem. *American Sociological Review*, 44, 948-967.
- Sommer, B.B. (1978). *Puberty and adolescence*. New York: Oxford University Press.
- Spindler, G.D. (1970). The education of adolescents: An anthropological perspective. In D. Ellis (Ed.), *Adolescents: Readings in behavior and development*. Hillsdale, IL: Dryden Press.
- Steinberg, L. (1987a). *The impact of puberty on family relations: Effects of pubertal status and pubertal timing*. *Developmental Psychology*, 23, 451-460.
- Steinberg, L. (1987b). Single parents, stepparents, and the susceptibility of adolescents to antisocial peer pressure. *Child Development*, 58, 269-275.
- Steinberg, L. (in press). Pubertal maturation and family relations: Evidence for the distancing hypothesis. In G. Adams, R. Montemayor, & T. Gullotta (Eds.) *Advances in Adolescent Development* (Vol. 1). Beverly Hills, CA: Sage.
- Stephens, W.H. (1963). *The family in cross-cultural perspective*. New York: Holt, Rinehart, & Winston.
- Stoller, R.J. (1970). Pornography and perversion. *Archives of General Psychiatry*, 22, 490-499.
- Tanner, J.M. (1955). *Growth at adolescence*. Oxford: Blackwell.

- Tanner, J.M. (1970). Physical growth. In P.H. Mussen (Ed.), *Carmichael's Manual of Child Psychology* (Vol. 1). New York: Wiley.
- Tanner, J.M. (1978). *Foetus into man: Physical growth from conception to maturity*. Cambridge, MA: Harvard University Press.
- Thornhill, R., & Thornhill, N.W. (1983). Human rape: An evolutionary analysis. *Ethology and Sociobiology*, 4, 137-173.
- Tobin-Richards, M.H., Boxer, A.M., & Petersen, A.C. (1983). The psychological significance of pubertal change: Sex differences in perceptions of self during early adolescence. In J. Brooks-Gunn & A.C. Petersen (Eds.), *Girls at puberty: Biological and psychosocial perspectives* (pp. 127-154). New York: Plenum.
- Touhey, J.C. (1974). Effects of dominance and competence on heterosexual attraction. *British Journal of Social and Clinical Psychology*, 13, 22-26.
- Trivers, R. (1985). *Social evolution*. Menlo Park, CA: Benjamin-Cummings.
- Turner, J.C. (1982). Intergroup conflict and cooperation. In A.M. Colman (Ed.), *Cooperation and competition in humans and animals* (pp. 218-249). New York: Von Nostrand Reinhold.
- van Gennep, A. (1909/1960). *The rites of passage*. Chicago: University of Chicago Press.
- Waddington, C.H. (1966). *Principles of development and differentiation*. New York: Macmillan.
- Watts, E.S. (1985). Adolescent growth and development of monkeys, apes and humans. In E.S. Watts (Ed.), *Nonhuman primate models for human growth and development* (pp. 41-65). New York: Alan Liss.
- Watts, E.S. (1986). Evolution of the human growth curve. In F. Falkner & J.M. Tanner (Eds.), *Human growth: A comprehensive treatise* (Vol. 1, pp. 153-166). New York: Plenum.
- Weisfeld, C.C., Weisfeld, G.E., and Callaghan, J.W. (1982). Female inhibition in mixed-sex competition among young adolescents. *Ethology and Sociobiology*, 3, 29-42.
- Weisfeld, G.E. (1979). An ethological view of human adolescence. *Journal of Nervous and Mental Disease*, 167, 38-55.
- Weisfeld, G.E., & Berger, J.M. (1983). Some features of human adolescence viewed in evolutionary perspective. *Human Development*, 26, 121-133.
- Weisfeld, G.E., Bloch, S.A., & Ivers, J.W. (1984). Possible determinants of social dominance among adolescent girls. *Journal of Genetic Psychology*, 144, 115-129.
- Weisfeld, G.E., & Feldman, R. (1982). A former street gang leader re-interviewed eight years later. *Crime and Delinquency*, 28, 567-581.
- Weisfeld, G.E., Muczenski, D.M., Weisfeld, C.C., & Omark, D.R. (1987). Stability of boys' social success among peers over an eleven-year period. In J.A. Meacham (Ed.), *Interpersonal relations: Family, peers, friends* (pp. 58-80). Basel: Karger.
- Weisfeld, G.E., Omark, D.R., & Cronin, C.L. (1980). A longitudinal and cross-sectional study of dominance in boys. In D.R. Omark, F.F. Strayers, & D.G. Freedman (Eds.), *Dominance relations: An ethological view of human conflict and social interaction*. New York: Garland.
- Whiting, B.B., & Whiting, J.W.M. (1975). *Children of six cultures: A psycho-cultural analysis*. Cambridge, MA: Harvard University Press.

- Wilson, M., & Daly, M. (1985). Competitiveness, risk taking, and violence: The young male syndrome. *Ethology and Sociobiology*, 6, 59–73.
- Wood, J.W., Smouse, P.E., & Long, J.C. (1985). Sex-specific dispersal patterns in two human populations of highland New Guinea. *American Naturalist*, 125, 747–768.
- Wrangham, R.W. (1982). Maturation, kinship and social evolution. In King's College Sociobiology Group (Ed.), *Current problems in sociobiology*. Cambridge, England: Cambridge University Press.

8

Psychological Development: Epigenetic Rules and Gene–Culture Coevolution

CHARLES J. LUMSDEN

Introduction

Contrary to the popular depictions, sociobiology is neither a particular theory of behavior nor a politically defined doctrine on human nature. In its present form it is a scientific discipline defined as the systematic study of the biological bases of all forms of social behavior in organisms, including humans. General sociobiology (Wilson, 1975), covering the facts and theories for all living creatures, can be usefully distinguished from human sociobiology (Lumsden & Wilson, 1981; Wilson, 1978), which addresses phenomena such as human language, cognitive development, and thinking.

A principal technical novelty of sociobiology is its treatment of societies as populations. Each animal society—each population—possesses a particular size, overall genetic structure, means of communication among the members, ratio of females to males, and other higher-order features. These traits can be observed as they change through time, just as the chemistry, neurobiology, and behavior of individual organisms are analyzed in biology. Sociobiology is closely allied to ethology, which can be defined roughly as the study of whole patterns of behavior under natural conditions. Both disciplines deal with the evolutionary history of species and behavior as an evolved trait. But where ethology focuses on the details of *individual* behavior, including the activity of the nervous and endocrine systems, sociobiology concentrates on the most complex forms of social behavior and their roles in the organization of *entire societies*. Sociobiology stresses both parts *and* wholes. The discipline, I should point out, is not founded on axioms to the effect that these wholes are “nothing but” what goes on at some low level of biological organization (such as in the genes). So although some sociobiologists are reductionists (they are, it seems, still everywhere), to do sociobiology is not to commit necessarily and a priori to reductionism.

Science is often concerned with *how* questions: how the understanding of number develops, how action potentials are generated, how genes

prescribe information. Sociobiology concentrates on *why* questions: why the pattern of human creative potential develops in a certain way, or why parents behave altruistically toward their offspring. The scientific query “why” can be answered only by the study of history, and the history of psychobiological processes is by definition evolution. Its creative process includes natural selection, the differential transmission across generations of genes that affect survival and reproduction. Evolution at times proceeds by means other than natural selection. Mutations can occur at such high frequency as to push up the percentage of mutants in the population without the aid of natural selection. Alternatively, immigrants can bring new genes into the population at a high enough rate to change the overall genetic composition of the population. If the population is a small one, random sampling effects caused by mating choices and genetic recombination can change the gene frequency in an unpredictable fashion from generation to generation. Sociobiology has extended this view of genetic evolution, which is generally accepted among population biologists, into the realm of social behavior and social organization.

Individuals do not duplicate themselves during the process of reproduction. They replicate their genes. From the viewpoint of evolutionary theory, and hence sociobiology, all of the traits of individuals are potential enabling devices for the expansive replication of hereditary material that affects these traits. Color vision, postsynaptic potentials, linguistic competence, cortical cytoarchitectonics, the tendency to enjoy music, and tenderness toward children are considered by classical sociobiologists to be, potentially, means by which genes spread through future generations.

Until quite recently sociobiology has attempted to link human genes and behavior in a direct manner. Using the idea that natural selection tends to dominate the evolutionary process, so that genes associated with increased survivorship or reproductive success spread through a population, researchers have sought to explain and predict the conditions under which dominance systems, altruism, pair bonding, parental care, homosexuality, play, and other forms of social behavior are most likely to arise during the course of genetic evolution. The method has been notably successful in the study of animals, which display more invariant, “instinctive” behavior. It has been successful to only a limited degree in the analysis of human behavior. New insights have been provided concerning very general human activities, such as incest avoidance, polygamy, family organization, and territorial defense (Alexander, 1979; Wilson, 1978).

However, this sort of thinking, based ultimately on concepts of genetic determinism, has not accounted for the properties of the human mind, including especially the activities of cognition and their ontogenetic development. Nor has it begun to contribute to a fundamental under-

standing of culture and social history. This situation has changed rather drastically in the past few years with the introduction of new methods not based on principles of genic selection and genetic determinism. Human sociobiology (e.g., Lumsden & Wilson, 1981, 1983, 1985) has begun to extend theoretical population biology to social populations that are dependent on culture and cultural transmission. From the standpoint of developmental psychology the merit of these advances is their extensive use of constructs in psychology and the neurosciences. For practically the first time in the history of evolutionary biology serious attention is being paid to the details of cognitive science and developmental psychology. The advantages to sociobiological scholarship, in terms of better models and arguments, need little emphasis. But for readers of this volume I would like to draw attention to a favorable reciprocal relation to developmental psychology: by placing development in the "why" perspective we can better discern its biological history and clarify why it has its particular properties, rather than some others conceivable in principle. The intent of such thinking is ultimately to predict the concordances between independent and dependent variables prior to the crucial empirical tests. My aim in this chapter is to take the reader on a brief tour through the findings and hypotheses about psychological development that have, to date, been forthcoming from modern human sociobiology carried out in this manner.

Psychological Development as Evolutionary Pivot

Evolutionary theories that do not explicitly deal with thinking and psychological development are unlikely to produce adequate descriptions of the human case. For humankind genetic determinism shapes (at most) processes involved in psychological development, not finished thoughts or behaviors. The transition from genes to individual behavior to overall patterns of culture can for the purposes of clarity be represented in initial approximation by a progression around a circuit of interactions (Figure 8.1) rather than by steps up a ladder of independent levels of organization. The feedforward of information from genes via individual development combines with the feedback from culture to genes. At the next level of organization in the circuit, behavioral acts are the beginnings of large-scale social phenomena. The resulting social and cultural patterns then form a principal part of the environment in which human genetic evolution takes place (Holloway, 1966; Lumsden & Wilson, 1983; Tobias, 1981). This process of reciprocating interaction, where behavior and culture potentially feel the effects of genetic information, which in turn may evolve in response to events in societal change, has been termed *gene-culture coevolution* (Aoki, 1986; Feldman, Cavalli-Sforza, & Peck, 1985; Findlay & Lumsden, 1986; Lumsden, 1985; Lumsden & Wilson, 1981, 1983, 1985).

The role of psychological development in sustaining gene-culture coevolution in the model conceived in Figure 8.1 is clearly pivotal. It is seen as the linkage that mediates between evolution at the genetic level and change at the level of cultural organization. While still simplistic some of the principal features of psychological development are captured in the model, particularly the formation over time of knowledge structures and information processes that operate on them, together with that certain style of deploying processes, best described as “personality” or “temperament” (Lumsden & Gushurst, 1985; Lumsden & Wilson, 1981; Masui & Lumsden, 1985). Questions such as single versus multiple intelligences (Gardner, 1983), specialized versus generalized competences (Fodor, 1983), the presence and rigidity of stages, and the roles of genetic information, cultural information, and individual decision making are suitable for investigation with sociobiological treatments constructed within this framework. Details of the methods and applications are available elsewhere; in the rest of this presentation I would like to focus on an issue that has been given perhaps the most extensive consideration thus far: sorting out the means by which genetic and cultural information actually contribute to individual psychological development, and placing these correctly within the circuit of coevolutionary interaction.

I begin with the observation that human memory tends to organize both continuous and discontinuous impressions into clusters that are at least semidiscrete. Experimental studies have shown that the cuts are made around objects or abstractions which have the most attributes in common and share the fewest attributes with other objects or abstractions. They appear to be a size that enhances efficiency in storage and transfer of information (Brunswick, 1956; Rosch, Mervis, Gray, Johnson, & Boyes-Braem, 1976). Hence while categories such as “fruit,” “fish,” and “furniture” do not exist in the real world, they comprise recognizable collections of objects that share an unusually large number of stimuli most easily processed by the mind. Children move naturally into this mode of memory formation, performing equally well on tasks that involve either objects or collections of objects. They organize the diagnostic stimuli into ensembles (such as “cookies” versus “crackers” and “bunch” versus “pile”) that are as sharply distinguished as the objects themselves (Markman & Seibert, 1976).

The processing is further enhanced by compounding the clusters hierarchically into larger assemblages. A convenient classification of the levels of clustering is the following (Horton & Mills, 1984; Wickelgren, 1979). The units of memory, which are experienced as objects or abstractions, are appropriately called *nodes*, aligning the description to the nodes and links between nodes envisioned in spreading-activation models of memory storage and recall (Anderson, 1983). At least three levels of nodes can then be recognized. Concepts, the most elementary clusters, are frequently tagged by words or phrases (such as “dogs” and

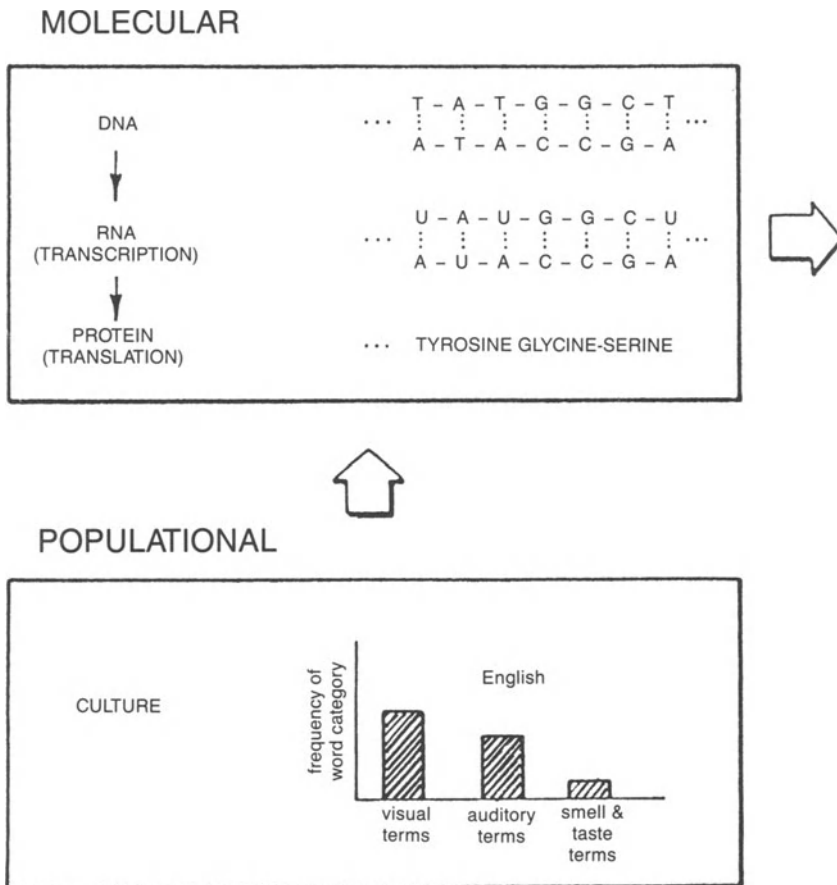


FIGURE 8.1. The circuit of gene–culture coevolution showing the principal levels of interaction. (From Lumsden and Wilson, 1981. Reprinted by permission.)

“hunt”). Vocalizable propositions are signaled by phrases, clauses, or sentences expressing objects and relations (“Dogs hunt.”). Finally, schemata having lexical equivalents are signaled by sentences and larger units of text (the “technique of hunting with dogs”). Node-link structures were originally proposed by psychologists as theoretical representations of stored knowledge, but they have gained considerable credence through empirical methods that detect their organization (Masui & Lumsden, 1985). The main steps in their growth are not merely the accidents of personal lifeways, but general processes that possess regularity across cultures (Dasen, 1972). Hence, in a manner important for the entire relation of biology and culture, the semantic

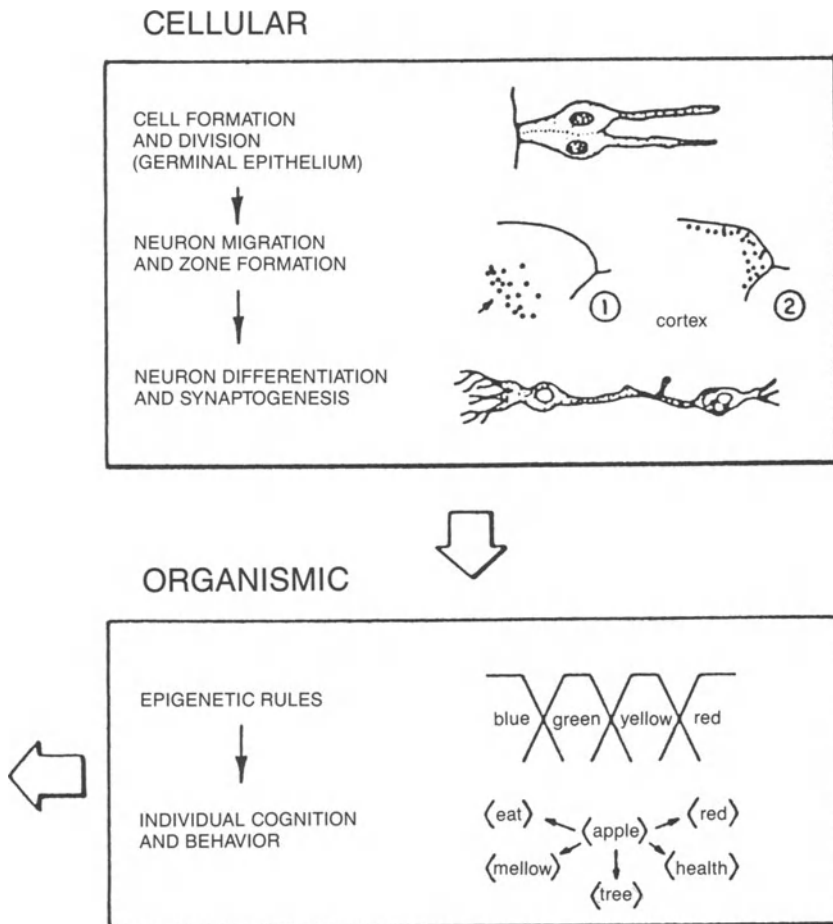


FIGURE 8.1. (Continued.)

mechanisms of culture formation are robust and consistent, perhaps more so than the final products they generate.

For each concept the mind tends to dwell on a prototype pattern that constitutes the standard, such as a particular wavelength and intensity to form the idealized color red or a particular body shape and size to form the typical shark (Medin & Smith, 1984; Rosch, 1973, 1975). Given an array of similar variants, the mind can construct a standard near the average of the variants and use it as the prototype even without having perceived any example of it directly (Kagan, 1984; Posner & Keele, 1968). The most important result for gene-culture coevolution is that the divisions, however “fuzzy,” are created and labeled, even when

the stimuli being processed vary continuously. In short, psychological development in humans tends to impose a semidiscrete, hierarchical order upon the world.

Most of the concepts comprising the basic entries within memory are subject to purely phenotypic variation arising from the particularities of cultural history. There is nevertheless a tendency for those belonging to at least a few categories to occur consistently across cultures. As Rosch (1975) has shown, such categories include elementary geometric forms (square, circle, equilateral triangle), the facial expressions of six basic emotions (happiness, sadness, anger, fear, surprise, disgust), and the basic colors (red, yellow, green, blue). To understand how species-wide universals in psychological development can occur within a coevolutionary system requires that we turn our attention to the logic of the development pattern.

Patterns and Directions in Psychological Development

EPIGENETIC RULES

Epigenesis is a term used by biologists to refer to the total process of interaction between genes and the environment during development. I would like to use it to describe psychological development as well. Thus during *mental* epigenesis, information acquired during socialization contributes to the formation of the mind and its contents, including the knowledge structures accessed through memory. In a process whose physiology is just vaguely understood, information encoded in the genes also influences this development. Recent efforts in human sociobiology have helped to clarify the range of possible forms this influence can take, as well as its most likely tentative form. The crucial point has been to recognize that in cognitive-developmental theory genetic feed-forward is often expressed in terms of innate constraints, written as rules weighting options or alternative pathways in the growth and differentiation of mental structures (Berwick, 1982; Simon, 1979; Wexler & Culicover, 1980). The rules act in concert to give an overall pattern or logical form to observed sequences of developmental events. It has been proposed that the term *epigenetic rules* be used in evolutionary studies to refer to these interacting components of the developmental logic (Lumsden and Wilson, 1981, 1983). Connection with genetics is made by noting that, in principle, changes in a gene could alter one or more epigenetic rules and the relations among them (the data on this point will be summarized below). In physiological terms, epigenetic rules of cognitive and behavioral development comprise one or more elements in a complex sequence of events occurring at various sites in the nervous system. Our analysis of the available data has led us to conclude that these elements are crudely but usefully separated into two main

categories (Lumsden and Wilson, 1981): primary epigenetic rules, which regulate the development of systems ranging from the peripheral sensory filters to perception, and secondary epigenetic rules, which assemble the inner mental processes (Fodor, 1983), including the procedures of consciously deliberated valuation and decision making.

THE THREE MODES OF TRANSMISSION

The epigenetic rules, if present, embody an innate part of the individual's strategy for learning culture. Several possible modes of their activity can be defined: *pure genetic transmission*, in which epigenetic rules prescribe essentially one developmental response to any culture trait or array of traits (hence, for example, an entirely “genetic culture” is a theoretical possibility); *pure cultural transmission*, in which the epigenetic rules prescribe genetically unbiased use of any culture trait in competition with others in forming knowledge structures or basic information processes (this is close to the traditional viewpoint of cultural determinism of *tabula rasa* individuals, widely applied in the social sciences; e.g., Harris, 1968; Freeman, 1983 for review); and *gene-culture transmission*, in which the epigenetic rules discriminate multiple culture traits and are more likely to use some rather than others, favoring certain routes at points where the pathway of mental development branches. The term *gene-culture* in the context is not meant to reiterate the truism that both genes and culture somehow influence human development. Rather, it describes transmission in the presence of innate epigenetic rules that predispose mental development to take certain specific directions in the presence of certain kinds of cultural information.

A preliminary evaluation of the relative importance of each transmission mode (pure genetic vs. pure cultural vs. gene-culture) can be carried out on the basis of available evidence. These data arise from two complementary methodologies. The first is developmental behavioral genetics, which attempts to uncover the causes of between-individual variation in various components of the cognitive phenotype throughout the period of development. For this approach, direct evidence of genetic influences on development is obtained from the demonstration that some proportion of the between-individual variance arises from genetic factors (see e.g., the lucid account by Plomin, 1983). A second approach concentrates on similarities of developmental patterns among individuals raised in different sociocultural environments (e.g., Hardy-Brown, 1983; Kagan, 1981; Slobin, 1982), with the assumption being that universality under widely different developmental conditions reflects a well-canalized developmental pathway. Although the point has been made elsewhere (e.g., Plomin, 1983), sufficient confusion remains to warrant reiterating that the two approaches are complementary:

behavioral genetics has little to say about normative issues. Direct evidence for genetic input to cultural universals is not obtainable from standard biometrical techniques; by definition there is no phenotypic variation to partition into genetic and environmental components. It is also worthwhile to note that inferences from cultural universals to a genetically directed developmental pathway must be constructed carefully and with appreciation for the tentative nature of the resulting assertions. Despite the presence of manifold differences among cultures, there are nonetheless some experiential components that indeed show a fair degree of cultural universality. For example, children spend their formative years within a structured family environment of some description. If cognitive development depends on these metacomponential aspects of the sociocultural environment, then cultural universality in various aspects of thought and behavior will also show the effects of *environmental* canalization as a result of a few metacomponential commonalities.

The data from behavioral genetics, augmented by neurogenetic studies, point to a genetic basis for the epigenetic rules. In addition, pedigree analysis and standard comparisons of fraternal and identical twins, in some instances strengthened by longitudinal studies of development, have yielded evidence of genetic variance in virtually every category of cognition and behavior investigated by these means, including some that either constitute epigenetic rules or share components with them. These categories include color vision, hearing acuity, odor and taste discrimination, number ability, word fluency, spatial ability, memory, timing of language acquisition, spelling, sentence construction, perceptual skills, psychomotor skill, extroversion/introversion, homosexuality, proneness to alcoholism, age of first sexual activity, timing of Piagetian developmental stages, some phobias, certain forms of neuroses and psychoses, and others (for reviews see Loehlin & Nichols, 1976; Lumsden & Wilson, 1981, 1983; R.S. Wilson, 1978). Single gene variants have been identified that affect certain cognitive abilities selectively (Ashton, Polovina, & Vandenberg, 1979), as well as the ability to discriminate certain odorants (Amoore, 1977). It has also become apparent that mutations at a single locus can result in profound but highly specific changes in the architecture and operation of brain tissues such as mammalian neocortex (Caviness & Rakic, 1978; Rakic, 1979). Not only do these alterations modify behavior at the locomotory and perceptual levels, but they may also introduce changes into such higher-level functions as choice and decision (e.g., Bliss & Errington, 1977).

Study of similarities in the developmental patterns among individuals suggests that much of human culture is sustained by gene-culture transmission rather than by pure cultural transmission. Whenever detailed studies have been conducted of development as mediated by

choice among or directedness toward empirically distinguishable culture traits, they have almost always revealed an innate bias favoring some over others. Examples include a neonate preference for sugar combined with an active aversion to salty and bitter flavors (Chiva, 1979; Maller & Desor, 1974), affecting the evolution of cuisine; the innate discrimination for four basic colors (red, yellow, green, blue) (Bornstein, Kessen, & Weiskopf, 1976a, 1976b) and a greater ease of learning color classifications clustered on these color modes (Rosch, 1973, 1975), affecting the evolution of color-term systems (Berlin & Kay, 1969; Lumsden, 1985; see further discussions below); infant phoneme discrimination, affecting later speech structure (Eilers, Wilson, & Moore, 1977); infant preference for certain kinds of visual patterns (Fantz, Fagan, & Miranda, 1975; Hershenson, Munsinger, & Kessen, 1965) regulating attention and arousal; neonate preference for normally composed facial features (a bias manifested within 10 minutes following birth) (Freedman, 1974) and locomotor patterns (Fox & McDaniel, 1982), orienting the infant learner toward human sources of information; smiling and other specific forms of nonverbal communication (Eibl-Eibesfeldt, 1979), facilitating the development of bonding, reciprocity, and communication; nonverbal signals used in mother–infant bonding, inducing long-lasting affects in later maternal care (DeCasper & Fifer, 1980; Klaus, Jerauld, Kreger, McAlpine, Steffa, & Kennel, 1972); sexual differences in the carrying of infants and other larger objects (Lockhard, Daley, & Gunderson, 1979; Salk, 1973); the fear-of-stranger response (Morgan & Ricciuti, 1973); the predisposition to acquire phobias against dangerous objects, such as heights, running water, and snakes, but not other dangerous objects including electric sockets and guns (Marks, 1969); the development of sexual preferences within the family (Shepher, 1971, 1983; van den Berghe, 1980, 1983; Wolf, 1968; Wolf and Huang, 1980), affecting adult mating behavior and social structure; the size and operating speeds of long-term memory and short-term memory, affecting the choice of strategies in conscious deliberation and problem-solving (Simon, 1979); the development of linguistic knowledge (Berwick, 1982; Chomsky, 1980; Wexler & Culicover, 1980); ontological knowledge, and knowledge about numerosity (Keil, 1979, 1981).

Existence or predominance of epigenetic gene–culture transmission in no way implies that cognition and behavior are genetically “hardwired” (i.e., that knowledge of the composition of an individual’s genome allows us to predict the behavior or cognition: in *Homo sapiens*, only a tiny fraction of stereotypical autonomous behaviors (such as reflexes) are innately determined). Rather, such epigenetic rules organize the logic of the individual’s developmental response to experience. In his seminal monograph *The Strategy of the Genes*, C.H. Waddington (1957) likened organic development to a ball rolling on a hilly surface. In the case of

complete environmental determinism, the surface is flat; the ball wanders erratically at every environmental stimulus. However, information in the genome has the potential to prescribe an uneven surface of shifting ridges and valleys of varying depths and elevations. For all but a few behaviors (corresponding to paths along the bottom of very deep, narrow valleys), human cognitive development is to a greater or lesser degree sensitive to environmental perturbation; the ball can, for example, be diverted from one valley to another. But it cannot perch upon a peak. In the case of psychological development, peaks in the epigenetic landscape represent inaccessible cognitive structures or processes circumscribed by the genetic constitution of the individual, while valleys demarcate the likely routes of mental growth.

DIRECTED DEVELOPMENT

These inferences about the existence of epigenetic rules for gene-culture transmission are consistent with the recent theoretical finding that the *tabula rasa* state of pure cultural transmission tends to be unstable in evolutionary time (e.g., Lumsden & Wilson, 1981). Even if the *tabula rasa* state is present initially, during the process of gene-culture coevolution a population of organisms is very likely to evolve rapidly into a condition where the ancestral phenotypes have been replaced by organisms equipped for gene-culture transmission. In a cultural species the genetic fitness of an organism is affected not only by its genotype but also by its cultural heritage as expressed by a subset of cultural information that is allowed to affect development. The genetic fitness is influenced by the pathway of enculturation that the organism follows and is enhanced by any tendency of mental epigenesis to use culturally transmitted information that confers greater relative genetic fitness. The innate epigenetic rules of gene-culture transmission provide this capability, guiding the organism to incorporate or respond to sets of relatively advantageous information more often than sets that are relatively deleterious.

Consider, in contrast, a population of *tabula rasa* organisms which alter the degree of influence over development exercised by cultural information without reference to the consequences for genetic fitness. The developmental field is flat and open. The population exists in an environment that will, in general, contain both adaptive and less advantageous culture traits. Its members are susceptible to learning experiences that could shape their preferences to favor deleterious behavior. Over a period of generations such a population tends to be unstable against invasion by genetic mutants with epigenetic rules that use culture traits favoring survival and reproduction. Because of their particular enculturation, strategies of directed development outcompete the *tabula rasa* design, with individuals leaving more offspring

generation after generation until eventually they constitute virtually the entire population. A relation between individual genetic fitness and a choice of behaviors, expected on the basis of this reasoning, has been explicitly documented in a wide array of real behavioral categories, including diet (Gajdusek, 1970), body marking (Blumberg & Hesser, 1975), sexual conventions (Daly & Wilson, 1978), marital customs (Daly & Wilson, 1978), economic practice (Irons, 1979), achieved socioeconomic status (Mealey, 1985), and others.

Some culture traits undeniably provide superior genetic fitness over others, but how is this possible? Survival and reproduction are not the products of an artifact lying in a campsite or an idea circulating in the recesses of long-term memory. They are fixed by explicit behavior, by muscular contraction and motion of parts of the body. The human mind intervenes to pose new strata of processes and transformations between enculturation and explicit behavior. Mental activity and outward behavior are based on the knowledge structures that make up the contents of the various cognitive domains. But if it is the case that culture and the development of the human mind are sustained by gene-culture transmission, then the knowledge structures are psychological entities built up in forms governed by the epigenetic rules. When organisms are predisposed to form certain mental structures and operations as opposed to others, the result is directed development.

In principle, the emergence of directed development during gene-culture coevolution could take the form of one or more innate constraining processes. First, it could result in part from sensory screening, which limits perception to narrow windows opening on the vast arrays of physical stimuli impinging on the body. Second, it could result from a tendency for certain knowledge structures to take form and link preferentially with others, including those related more directly to activities in the limbic and brain reward systems, so that they are more likely to become differentially associated with particular informational, valuational, and emotive constructs. For example, bonding results from the virtually automatic positive linking of mother and infant during their initial contacts, whereas snakes, heights, and other typical subjects of human phobias are likely to acquire negative valuation and become tagged as objects of avoidance behavior. Third, directed development could result from the existence of constraints on achievable cognitive design, biasing development toward certain parameters of information-processing capacity rather than others. Thus the symbol capacity of short-term memory is on the order of three to seven elements or chunks, while the comparatively infinite store of long-term memory admits new elements much more slowly than it allows them to be retrieved (Newell & Simon, 1972; Simon, 1979). The effects of these characteristics on the selection of search and computational strategies have been noted in many areas of human reasoning and problem solving

(Bradshaw, Langley, & Simon, 1983; Larkin, McDermott, Newell, & Simon, 1980; Simon, 1979, 1981). Overall, the directivity in psychological development may lead to a substantial similarity in the forms of mental activity among the members of societies and even among peoples belonging to different cultures (for reviews see Hallpike, 1979; Lumsden & Wilson, 1981; Williams, 1972). Idiosyncracies in concept formation and all other aspects of development obviously distinguish one human being from another—often remarkably so. But the epigenetic rules of gene-culture transmission appear to be sufficiently tight to produce a broad overlap in mental activity and behavior of all individuals and hence a convergence powerful enough to be labeled *human nature*.

Epigenetic Rules in Action

Because of their particular importance and suitability for sociobiological analysis, a small number of cases in psychological development have been looked at in substantial detail. Some of these provide striking views into the activity of epigenetic rules and the process of gene-culture transmission. They also clarify in practical terms the meaning of the more general theoretical notions introduced above. In the following section I have briefly summarized four cases that have begun to strongly influence sociobiological thinking about psychological development: sibling incest, color categorization, language acquisition, and musical understanding.

SIBLING INCEST AVOIDANCE

The avoidance of incest is a pivotal subject for the social sciences. Many cultural anthropologists have shared the view of Levi-Strauss (1969) that in the practices of incest avoidance human beings are cast free from their biological history and guided instead by idiosyncratic cultural systems of taboos and rituals.

A different line of reasoning begins with the observation that incest taboos are a cultural universal. For example, virtually all of the hundreds of societies have imposed a ban on brother-sister mating, while permitting or even encouraging it between first cousins. Only a very few, such as the Incas, ancient Egyptians, Monomotapa of Zimbabwe, Nyanza of Zaire, and Shiluk of the Sidan, have permitted this form of pairing, and then usually only in the case of royalty or in certain noble families. Van den Berghe and Mesher (1980; see also van den Berghe, 1980, 1983) point out that in all the known incestuous arrangements, polygyny, the taking of multiple wives, is (or was) practiced by the

incestuous males, resulting in a net outbreeding and an overall increase in personal evolutionary fitness. Royal women, on the other hand, were much less likely to marry downward in rank and were thus more susceptible to marriages with their siblings.

Studies by Shepher (1971, 1983) and others on the development of sexual preferences of children in Israeli kibbutzim indicate that there exists a relatively specific epigenetic rule in this cognitive domain, whereby an automatic neutralization of sexual interest emerges among people who have lived intimately together (“used the same potty”) during the first six years of life. This epigenetic rule is not directed precisely at biological siblings. It will respond to any child with whom the young individual lives in close association, an arrangement that is likely to generate sibling incest avoidance when it operates within the context of the human family structure. Among the 2,769 kibbutz marriages counted by Shepher, none took place between members of the same kibbutz peer group that had lived together since birth. He did not detect a single known case of heterosexual activity, even though kibbutz adults were not opposed to peer-group sexual activity among adolescents.

Another natural experiment leading to similar conclusions occurred among Taiwanese families who adopted very young girls for the purposes of household work and later marriage to the hosts’ sons. Such arrangements, although frequently contracted and sanctioned by the society at large, failed at a remarkable rate. In the great majority of cases the couples refused to accede to the marriage, because of probable sexual inhibition based on early domestic contact (Wolf, 1968; Wolf & Huang, 1980). When such marriages were actually undertaken they ended in separation and adultery far more often than did unions between individuals who had not been raised together. They also produced substantially fewer children than did the other marriages. The evidence suggests the existence of an innate epigenetic rule in which the resulting preference structure is strongly opposed to incestuous activity.

In American families brother-sister incest does occur, but is again relatively rare, transient, and ordinarily a source of shame and recrimination (Weinberg, 1976). The usefulness of the sociological data on industrialized societies is compromised to some extent by the differing standards that investigators (and informants) apply when judging an act to be incestuous. In taking into account the Israeli and Taiwanese data I have set a relatively robust criterion, namely, full sexual activity ending in intromission and copulation between siblings of the opposite sex.

For the epigenetic rule of sibling incest avoidance the underlying evolutionary rationale seems to be relatively clear. The well-documented result of brother-sister mating is a higher frequency of genetic deformation in the offspring (Seemonova, 1971; Stern, 1973). Thus the

possession of an epigenetic rule innately biasing individual behavior away from incestuous activity is expected to confer enhanced reproductive success.

COLOR CATEGORIZATION

Although lexicon size varies, all human societies so considered have terms for colors or degrees of light and dark (Kay & McDaniel, 1978). The explanation of the ethnographic distribution of color terms and their evolution has been labeled an important anthropological issue (e.g., Berlin & Kay, 1969). The neurophysiology of color perception has also been extensively studied using human subjects and primate models (Lennie, 1984). Discussion of ethnographic distributions of color naming has therefore taken on an increasingly biological tone (Bornstein, 1973; Kay & McDaniel, 1978; Whitfield, 1980). Moreover, the study of color categorization has recently been extended to very young infants prior to the onset of language acquisition (Bornstein, 1975, 1979, 1981; Bornstein & Marks, 1982). It is possible, therefore, to begin to compare the performance of humans who have not yet begun color-term socialization through language with that of fully enculturated adults. Qualitative correspondences between the color categories perceived by young infants and by the adult populations examined by psychologists have been previously noted (Bornstein et al., 1976a, 1976b; Lumsden & Wilson, 1981).

A quantitative study reported by Lumsden (1985) considered the specifications of infant color categorization obtained by Bornstein and his co-workers (Bornstein, 1975, 1979, 1981). Sixteen-week-old infants were found to respond to variation in wavelength as though four basic color categories were being discriminated. Conventional terms for these categories would be *red*, *yellow*, *green*, and *blue*. The categorization was detected by measuring the span of the infant's attention to monochromatic lights ordered across the visible spectrum. Within a short time the infants habituated to the repeated presentation of the stimulus light. Recovery from habituation was strong only when changes in wavelength crossed certain wavelength values, which were judged to be the boundary regions between perceptual categories of color. Boundaries between the categories were mapped, together with the perceptual responses near the category centers.

To quantify the relationship between the infant data and the ethnographic observations, boundary values between infant categories were identified (Lumsden, 1985): *red-yellow* at 600 nm, *yellow-green* at 560 nm, and *green-blue* at 480 nm. The values given correspond to the peaks of maximum wavelength discriminability in the boundary regions (Bornstein, 1981) and to the midrange crossover points between the

respective categories as measured by Bornstein, Kessen, & Weiskopf (Bornstein et al., 1976a, 1976b). The width of the boundary regions is in all cases narrow: 20 nm for *red-yellow*, 10 nm for *yellow-green*, and 20 nm for *green-blue* (Bornstein, Kessen, & Weiskopf, 1976a, 1976b).

The ethnographic observations were drawn from the data on color naming developed by Berlin and Kay (1969). In the Berlin-Day study, native speakers of 20 languages were shown arrays of patches ordered in color and brightness by the Munsell system. A list of basic color terms (terms operationally defined to include such characteristics as monolexemic structure and broad applicability) was elicited from each subject. Subjects were then asked to place each basic color term of their native language on the two-dimensional color chart by picking the color patch or patches that best represented each term. Except for the 40-member Tzeltal group, the subjects were bilingual in their native language and American English. The Tzeltal subjects varied from monolingual fluency in Tzeltal to Tzeltal-Spanish bilingualism. The close accord observed between the response patterns of the Tzeltal speakers and those of the other informants suggested that biases arising from bilingual ties to American English were not substantial. The center of gravity of the best-exemplars was plotted by Berlin and Kay for each basic color term in each language.

The Berlin-Kay (BK) map was analyzed by Lumsden (1985) in quantitative terms. The Munsell brightness axis holds the dominant wavelength of the color patches approximately constant. To allow tests of correspondence with the four infant spectral categories, the BK color groups were clustered on the basis of vertical order to bring together all sample points in a given dominant wavelength range. This procedure led to BK red forming RED (R), BK brown, orange, and yellow forming YELLOW (Y), BK green forming GREEN (G), and BK blue forming BLUE (B) (Figure 8.2). Lateral boundaries for the clusters were those reported by Berlin and Kay for their original color groups (Berlin & Kay, 1969). Two data points from BK pink fell in the Munsell patch (R5, 8), vertically aligned with BK red, and were included in RED.

Values of the dominant wavelength and excitation purity (saturation of the color patch emission by the dominant wavelength) were determined for each data point observable on the BK map. So transformed into wavelength equivalents, the Berlin-Kay data were compared to psychological studies of infant categorization. The qualitative correspondence between the infant category structure and the BK ethnographic distribution proved to be quite marked (Figure 8.3). The boundaries of the ethnographic clusters align closely with those of the infant categories. In this figure the histograms of sample points represent distributions of wavelengths that speakers of different languages judge to be best examples of particular colors. Thus Figure 8.3 presents wavelength ranges that infants group as similar in hue against

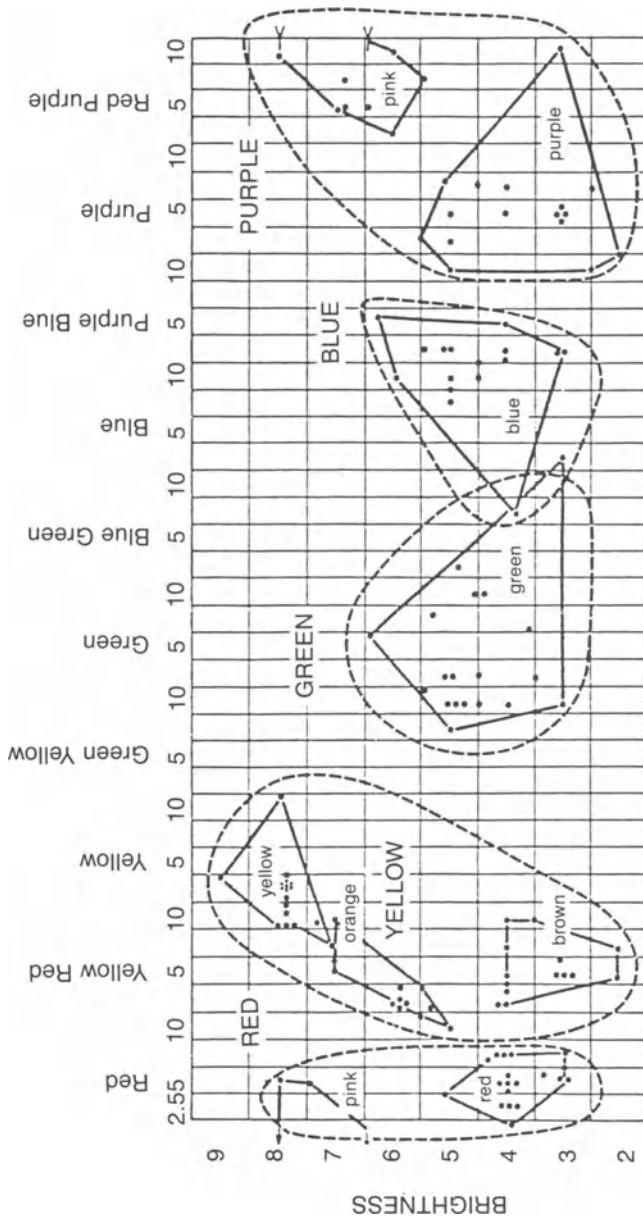


FIGURE 8.2. Clustering of the Berlin-Kay color-term groups into four major spectral hue categories: red, yellow, green, blue. Purple corresponds to a nonspectral purple and was omitted from the analysis (see text). *Solid polygons*: original groups according to Berlin and Kay (1969). *Dashed lines*: proposed clusterings. (From Lumsden, 1985. Reprinted by permission.)

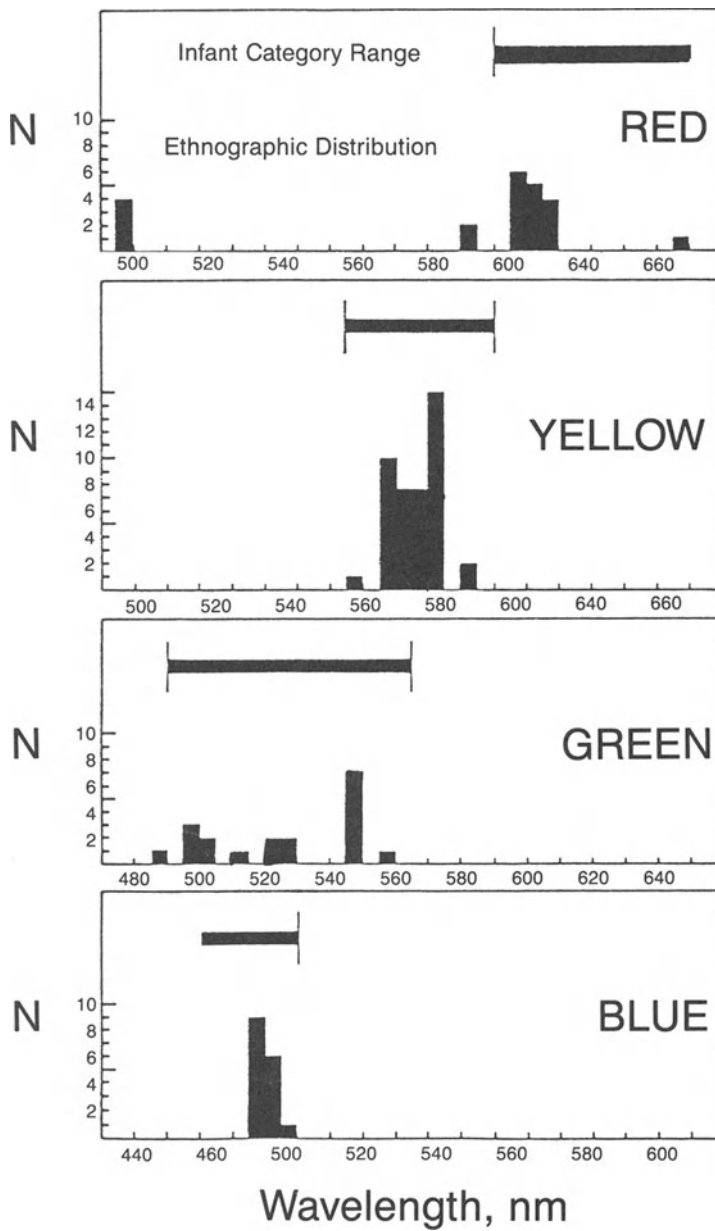


FIGURE 8.3. Alignment of the infant color categories (Bornstein, Kessen and Weiskopf, 1967a,b) and the Berlin–Kay ethnographic distribution of basic color terms. (From Lumsden, 1985. Reprinted by permission.)

wavelength ranges that adults from different linguistic communities each label the same way.

To quantify the relationship each of the data points on the BK map was assigned to an infant category on the basis of its dominant wavelength compared to the values selected for the boundaries between the infant categories. The results were organized into a 4×4 cross-tabulation of the infant categories and the categories of the BK ethnographic distribution. In this form the data showed a striking diagonal order, with most of the ethnographic BLUE points falling in the cell corresponding to infant *blue*, and similarly through GREEN, YELLOW, and RED. The strength of this association was highly significant: $\chi^2 = 246.5$, d.f. = 9, $p < .001$; Spearman's rho = .88; Kendall's tau B = .86. The measures of category association obtained in this and subsequent procedures indicate that between 75 and 95% of the variance in the membership in the ethnographic color categories is accounted for solely by the prelinguistic infant color categories.

These results suggest that the wavelength clustering of the BK ethnographic color term distribution can be parsimoniously explained on the basis of an epigenetic rule (Lumsden & Wilson, 1981) serving color category development. This epigenetic rule involves procedures of color discrimination present since early infancy. Other findings also support such a conclusion. Bornstein has related the centers of the BK clusters to response peaks of neurons in the noncortical visual systems serving color processing (Bornstein, 1973). Similar correspondences have been documented at length by Kay and McDaniel (1978). Related patterns of clustering are also detected in studies that consider the more complex cortical processing associated with color constancy awareness (Land, 1983; Zeki, 1983). Investigation of color categorization has also been extended to nonhuman primates. The macaque, whose visual system appears neurophysiologically similar to the human case, categorizes the spectrum into similar basic categories of *red*, *yellow*, *green*, and *blue* (Sandell, Gross, & Bornstein, 1979). The chimpanzee, *Pan troglodytes*, when trained to use symbols to name colors, organizes its responses to the BK color chart in much the same way as did human subjects (Matsuzawa, 1985). Whether these properties are shared on the basis of parallel adaptation or descent from a common ancestor remains to be determined.

Of course, the fact that the basic hue categories of infants, which resemble those of the macaque and chimpanzee, account for most of the structure in the ethnographic data does not imply that culture is irrelevant or plays no role. Color terms themselves are part of the language system and are transmitted culturally. Human societies differ greatly in the complexity of their color lexica and in the ways in which color terms are used in social exchange (Berlin & Kay, 1969; Ratliff, 1976). Identification of the epigenetic rule does not address the determinants

of this complexity or the associated systems of conventions. The social evolution of color-term systems is also an involved process whose regularities might be explained by a combination of cultural and biological mechanisms (Bornstein, 1973; Kay & McDaniel, 1978; Ratliff, 1976; Whitfield, 1980; Witkowski & Brown, 1977). However, an epigenetic rule for basic color categories would indicate that these important processes of language evolution have been occurring in a manner consistent with innate constraints operating since early infancy.

LANGUAGE ACQUISITION

It is of great interest that of all the cognitive domains, linguistic knowledge has most often been singled out as a paradigm of the manner in which the human mind differs from that of its primate ancestors (e.g., Hockett & Ascher, 1964). The older evolutionary literature abounds in stories about how a facility for language would have been helpful to earlier hominids. These well-known presentations are somewhat too numerous, and at the present time, unfortunately, rather too “just so” in their content to warrant coverage here.

Traditional social science models have generally taken language to be the instrument through which culture imposes its idiosyncratic form on the human mind (e.g., Gleason, 1961; Whorf, 1956) but the combined evidence of psycholinguistics, neurobiology, and human genetics suggests that this extreme position should be approached with caution. Instead, it appears likely that the ontogeny of linguistic knowledge structures is the result of mental operations carried out on cultural cues under the guidance of a rich set of innate developmental instructions.

The signs of epigenetic rules operating in the domain of linguistic knowledge have been detected piecemeal by a number of investigators. Infants possess innate rules of speech perception that are adultlike and facilitate the development of language (Eimas, 1985; Eimas, Siqueland, Juscquik, & Vigorito, 1971; Liberman, Cooper, Shankweiler, & Studdert-Kennedy, 1967). Whereas variations in pitch are perceived as arrayed along a smoothly varying continuum, distinctions of voicing are automatically classified into categories—in this case, into phoneme clusters. For example, sounds ranging between /ba/ and /ga/ and between /s/ and /v/ are clustered on the basis of perceived similarity into one or the other of these paired units. A principal component of the discrimination process is the voice onset time (VOT) for phonemes, which is the timing of the acoustical formants or energy bands relative to one another. The recognition of stop and fricative consonants, for instance, depends on the extent of the first formant and the direction of the second formant. This development of phoneme discrimination is channeled, moving through more than one stage during the first year of life or longer (Eilers, Wilson, & Moore, 1977). In the 11 languages surveyed by Lisker

and Abramson (1964) one or more values along each VOT continuum served as reference points, dividing the continuum into two or three phonetic clusters. Ultimately a repertory of from 20 to 60 phonemes develops around the reference points, the total number varying according to culture.

Psycholinguists have pointed out the impressive speed and precision with which linguistic knowledge develops in children of all cultures. Some have contrasted this state of affairs with the seeming absence from childhood linguistic environments of the order and completeness required for a developmentally unconstrained inductive learner to achieve competence (e.g., Wexler & Culicover, 1980, and references therein). Put briefly, there is a "paradox of the poverty of the stimulus" (Chomsky, 1980): how can linguistic knowledge develop in children when their environments apparently lack information in the requisite quantity and form?

A possible answer is that their genes provide the missing clues by way of innate developmental constraints specialized for language acquisition. These channel the assembly of linguistic knowledge to successful completion (Chomsky, 1980; Keil, 1981; Pinker, 1981), and as a corollary have partially shaped language and its cultural evolution. Wexler and Culicover (1980) present empirical and extensive theoretical evidence of the existence and universality of certain such constraints in human language systems. In important related work Berwick (1982; see also Berwick, 1985) has built an acquisition front-end for the English-parsing software system PARSIFAL and demonstrated that, given similar types of constraints, it can acquire rules for parsing English syntax.

Linguistic theory is in a phase of rapid development, and it is possible that specific epigenetic rules will have to be rethought in the light of new developments. But already the work of Wexler, Culicover, Berwick, and their associates has provided a first glimpse of the epigenetic field in one of the most complex human cognitive domains shaped by gene-culture coevolution.

MUSICAL UNDERSTANDING

Language, creativity, and aesthetic awareness rank high on the list of our species' evolutionary attainments. The sociobiology of human creativity and imagination recently has been discussed in some detail in Findlay and Lumsden (1986). An overview of the historical background and an extensive bibliography referring to development and epigenetic rules are available in that source. With respect to aesthetic awareness, an important advance has been reported in the study of musical understanding (for an overview of the sociobiology of aesthetic awareness in general see Maxwell, 1985). Lerdahl and Jackendoff (1983) have presented a monograph-length theory of the cognitive procedures

people use to organize auditory perceptions of Western tonal music into the forms consciously experienced (Figure 8.4). These forms are referred to as *musical intuitions*. Lerdahl and Jackendoff characterize them in terms of the four technical properties of grouping, metrical structure, time-span reduction, and prolongation reduction. The cognitive symbol or symbols for each characteristic are hypothesized to encode a structure, strictly hierarchical in general, that incorporates all the pitch-events heard. The structural descriptions are formed in a largely unconscious, rule-governed process and represent the listener's understanding of the piece. Lerdahl and Jackendoff suggest that the cognitive rules comprise a grammar organized into categories of well-formedness rules, transformational rules, and preference rules. A surprisingly small number of rules, which themselves can be concisely expressed, are shown to provide a comprehensive description of the musical surface. The flavor of these rules can be appreciated by looking at a few examples (Lerdahl & Jackendoff, 1983:pp. 347,349,351):

MWFR 1

Every attack point must be associated with a beat at the smallest metrical level present at that point in the piece.

TSRWFR 4

If a two-element cadence is directly subordinate to the head e of a time-span T , the final is directly subordinate to e and the penult is directly subordinate to the final.

PRPR 1

In choosing the prolongationally most important event e_k of a prolongational region $(e_i - e_j)$, strongly prefer a choice in which e_k is relatively time-span-important.

The system is formally put and targeted directly at the analysis of musical surfaces. The use of preference rules (such as PRPR1) is particularly interesting. Application of the rest of the grammar may yield multiple legitimate orderings of the musical surface. The preference rules operate on these to make the selection of some more likely than others. But the process is probabilistic, not deterministic, and may vary from individual to individual or between repeated hearings of the same musical surface. An intriguing stochastic element is therefore introduced into the path along which musical intuition will flow. This non-deterministic nature, combining directivity with flexibility (the latter achieved through the variable applicability of individual rules among pieces as well as a probabilistic preference structure) has been argued on sociobiological grounds to be a likely property of epigenetic rules in general (cf. discussion in the previous section).

Lerdahl and Jackendoff consider the question of innateness and propose that a substantial number of the rules for musical understanding may be genetically determined. Especially likely candidates are rules that apply to partially processed structural analyses far removed from the pitch-events in the musical surface. The authors suggest that learners are unlikely to infer sufficient evidence to construct such abstract knowledge on the basis of generalizations from listening to music—an argument similarly applied by some psycholinguists to language acquisition (see above). These rules may in turn be musical universals, properties common to the grammars applicable to different musical idioms. The possibility of testing the innateness hypothesis, using historical and ethnomusicological techniques, appears to be substantial (Lerdahl & Jackendoff, 1983:282). If so these primary efforts will give valuable new data on the epigenetic rules at work in one of the most interesting, and previously mysterious, forms of human thinking.

Culture and Its Role

In gene-culture transmission, behaviors and patterns of thought are not determined genetically. The human mind develops them from information it acquires during socialization. This information, combined with its shifting patterns of meaning and significance, comprises culture in the sense implied till now in my discussion. In this concluding section I would like to be somewhat more explicit about what I consider to be the principal relevant properties of culture (relevant to understanding gene-culture coevolution, that is) and their role in psychological development. This is a big topic, so my remarks will of necessity be preliminary and rather sketchy (for further discussion see Lumsden & Wilson, 1985, and Findlay & Lumsden, 1986).

FIGURE 8.4. Cognitive ordering of musical experience. *Top staves*: theme of Mozart's K. 331. *Tree-structure representation*: the time-span reduction associated to the pitch events in the K. 331 theme by the rules in the Lerdahl-Jackendoff (1983) theory of musical understanding. The representation is the output of a cognitive process operating on the pitch events in the musical surface. Its cognitive function is to encode the listener's organization of the surface into a hierarchy of structural importance within each rhythmic unit of the piece. The *dotted lines* across the tree signify slices that intersect the branches represented in the corresponding lines of music. Thus for example line (d) intersects the branches for the first and last events of the passage. When read (or played) in order (e) to (a) the Mozart theme is heard to emerge as an elaboration of a basic melodic and harmonic progression. Many of the rules guiding the listener's analysis may be innate. (Diagram courtesy of Ray Jackendoff.)



First some points about pattern and order. Although the details vary (Kroeber & Kluckhohn, 1963), there is partial agreement among anthropologists that culture is a system of information, socially transmissible, influencing the behavioral, affective, and cognitive attributes of a social group, including such aspects as individual skills, knowledge, attitudes, beliefs, and collective myths and rituals (Keesing, 1976; Kroeber & Kluckhohn, 1963). This description of culture is often extended to include the actual lifeways and material artifacts that are the overt expressions of the transmissible information. I will mainly be concerned with the informational aspects *per se*.

An extensive literature summarizes evidence that human cultures, as information systems, possess some degree of inner order (for overviews see Murdock, 1967; Naroll & Cohen, 1970). The discourse and body movements experienced in tasks, rituals, demonstrations, and other means of transmission can be hierarchically clustered as sets of phonemes, words, sentences, stories, and analogous components of motor patterns (Laban, 1975). Considerable attention has focused on the elements of these various sets as natural units or building blocks of culture. In culture theory and human sociobiology previous authors have referred to units of culturally transmitted information in diverse ways, such as mnemotype, idea, idene, sociogene, instruction, culture type, meme, and concept. (The history of the terminology is discussed more fully in Lumsden & Wilson, 1981.) This discussion has been further stimulated by the findings of Shannon (1948) and later students of information theory (Brillouin, 1962; Chaitin, 1975; Gatlin, 1972), in which systems of transmissible information are objectified and ultimately ordered into quantifiable patterns composed of basic units. At the same time a small but very vocal group of investigators have vehemently denied the merit of pursuing cultural "units" (e.g., Hallpike, 1985, and references therein).

The reason for all the interest and controversy over culture units is that among human sociobiologists theories of genetic inheritance are being used as templates for the models of gene-culture inheritance. At some point all gene theories make contact with the assumption of discrete, particulate units (the genes) being passed from generation to generation. From the standpoint of molecular physiology this is a sensible proposition. Unfortunately, interactions among the units are usually shoved into side terms vaguely labeled *epistasis* and, in the interests of mathematical tractability, ignored as quickly as possible. The resulting schema, in which each discrete unit propagates along its evolutionary way, can look terribly naive as a sound metaphor for culture. However, the dispute has tended to confuse the issue of whether culture as it acts in development has basic "units" (which, as we will see below, seems a reasonable first approximation and may even be true) with questions about interactions and meaningful couplings among the

units (which undoubtedly exist aplenty and are not necessarily done away with when one works with “units”). It has also drawn sociobiologists’ attention away from other, perhaps unique, aspects of culture and given this information system a mathematical look little different from the genetic one. I will return to this point later.

The important problem of the existence of units can be resolved at least in part by reviewing the mechanics of gene-culture transmission. In order to understand the necessary steps, let us consider an analogy from molecular biology. The genome is commonly envisaged as consisting of parts, the genes, that have an objective existence. The data on this seem overwhelming. However, inspection of an actual nucleotide sequence reveals only a continuous genetic text lacking breaks or pauses. Now human observers are at liberty to develop any number of useful decompositions or classifications for such sequences of nucleotide letters, for whatever variety of uses they deem appropriate. But there is one decomposition whose biological meaning is known to be of the greatest significance, namely that corresponding to the genetic code. By following this code, the cell’s transcription-translation apparatus imposes a unique decomposition. It translates as *start* (of gene) and *stop* (end of gene) certain triplets of adjacent nucleotide letters, producing the developmental equivalent of decomposing the whole genome into natural units. These are the genetic sequences that code for discrete, functional polypeptides. (At the molecular level, transcription, translation, and gene-control are developmental events).

Considerable insight into units of culture can be had, I think, by noting that the relation of *culture* to the *epigenetic rules* appears to be similar in a functional sense to the relation between nucleotide letters and the cellular apparatus for transcription/translation. During individual mental development culture, roughly speaking, is scanned by the epigenetic rules. Our discussion earlier suggests that the rules are set to respond to certain cues or patterns within the cultural system and that these act as detectable signals influencing development. They are the units of culture. Thus while culture might be decomposed in a great many different, academically significant ways, there is one *natural* decomposition of culture sustaining *mental development*: that produced by its interaction with the epigenetic rules. It is important to note that this characterization does *not* state that culture consists a priori of atomic units or symbols. Rather, such *units* are the emergent result of culture experienced *as a whole* by the individual.

It would seem that the activity of epigenetic rules in mental development may make it possible for human sociobiology to take the crucial steps delineated by Rosenberg (1980) for building more powerful middle-range theory in the behavioral and social sciences: identification of natural units and the linkage of explanations across disciplines through the relation of these elements. It also encourages a careful distinction

between two conceivable kinds of units: *structural units*, which are phenotypic traits detectable within larger patterns, and *generative units*, which are structural units that act through a coding process to generate other structures. Just as genes are generative units for the RNA and (ultimately) protein, epigenetic rules extract generative units from culture and, during psychological development, use them to assemble knowledge structures and mental representations, culture's inward manifestations.

A question of immediate interest is therefore the nature of the generative unit active in psychological development and cultural transmission. It appears possible that this element, which in earlier studies we have called the *culturgen* (Lumsden & Wilson, 1981, 1983), can be equated to the node of semantic memory. The level of the node, whether concept (the most elementary recognizable unit), proposition, or schema, determines the complexity of the generated behavior or artifact maintained in the culture. For example, the differentiation of letters in an alphabet is at the level of the concept, the initial verbal reaction to a stranger is a proposition, and the lexical expression of an incest taboo is a schema.

Although a direct correspondence between nodes and generative units of culture appears feasible at lower levels of organization, there is no reason to expect the more complex constructions of culture to be mapped onto semantic nodes in a one-to-one fashion. Subjects of cultural anthropology such as marriage ceremonies and the architecture of temples are the outcomes of numerous interlocking behaviors that result from cognitive activity accessing multiple knowledge structures. These in turn vary according to the particularities of local history. Nevertheless, each can be realistically interpreted as the outcome of human mental development, which involves the assembly of knowledge structures and their processing mechanisms.

None of this elaboration assumes or implies that generative units stand independently of one another. Indeed, the mechanism of gene-culture transmission would suggest that in general the opposite is much more likely to be the case, with strong couplings among units produced by their triggering of multiple interacting epigenetic rules and the resulting cascades of information processing. Ostensibly different cognitive domains, such as incest avoidance and color terms, may use very different sets of cues and triggers, whereas the sets for other domains (language acquisition and musical understanding, for example) may overlap considerably, with much linkage and interaction among the units. In any case there appears to be no reason to assume that the generative units serving a particular domain will be individually isolated in any meaningful sense of this term.

Although significant progress is being made on cultural units and their role in psychological development and gene-cultural transmission,

human sociobiologists are still paying insufficient attention to other properties of culture. Almost all of these remain to be appreciated, formally defined, and evaluated, despite their obvious importance to cultural anthropologists and their possible roles in psychological development. For example, culture seems to have a deeply hermeneutic, polysemic form in which levels of meaning are nestled one within the other and compete for the learner's attention (Geertz, 1984). Human sociobiologies capable of treating this order of complexity are only now making their appearance (Findlay & Lumsden, 1986). Similarly, the intrinsically dialectical aspects of culture (Barrett, 1984; Harris, 1968) have been largely bypassed despite the apparent role of the juxtaposition of opposites, with subsequent reconciliation of dissonance and apparent contradictions, as a guiding factor in mental development (review in Findlay & Lumsden, 1986). But like elementary particles, culturgens may come in mutually annihilating pairs, each culturgen encoding an opposing meaning or contradictory developmental choice. The impact of such oppositions as they work through a society has long been recognized (Harris, 1968). The next steps in human sociobiology will be deeply concerned with these and other properties that give culture its unique properties and human development its unique ability to form complex minds.

I have suggested that the epigenetic rules of mental development shape the manner in which concept nodes are created and linked to form semantic networks. The underlying physiological processes impose a strict filtering of stimuli from the environment and alter each event of mental life thereafter, from short-term memory and storage in long-term memory to recall, feeling, reverie, and decision making. As a consequence the difference between genetic and cultural inheritance can be summarized as follows: In genetic inheritance the basic information, encoded in DNA, is directly replicated and transcribed unidirectionally out through RNA and protein. The information in cultural inheritance, encoded in the semantic networks, cannot replicate itself directly and must generate culture in order to reproduce. The process involves the logical equivalent of the reverse transcription forbidden in genetic inheritance. The two inheritance systems are linked: because of the intervention of the epigenetic rules, which have a genetic basis, culture is based not just on learning but also, ultimately, on the particular structure of DNA.

Acknowledgments. I thank Anne Hansen for her careful preparation of the typescript. Financial assistance for the work reported here was provided in part through Population Biology Grant Number A0393 of the Natural Sciences and Engineering Research Council of Canada and a career scholarship from the Medical Research Council of Canada.

REFERENCES

- Alexander, R.D. (1979). *Darwinism and human affairs*. Seattle: University of Washington Press.
- Amoore, J.E. (1977). Specific anosmia and the concept of primary odors. *Chemical Senses and Flavour*, 2, 267–281.
- Anderson, J.R. (1983). *The architecture of cognition*. Cambridge, Ma.: Harvard University Press.
- Aoki, K. (1986). A stochastic model of gene-culture coevolution suggested by the “culture historical hypothesis” for the evolution of adult lactose absorption in humans. *Proceedings of the National Academy of Sciences of the United States of America*, 83, 2929–2933.
- Ashton, G.C., Polovina, J.J., & Vandenberg, S.G. (1979). Segregation analysis of family data for 15 tests of cognitive ability. *Behavior Genetics*, 9, 329–347.
- Barrett, S.R. (1984). *The rebirth of anthropological theory*. Toronto: University of Toronto Press.
- Berlin, B., & Kay, P. (1969). *Basic color terms: Their universality and evolution*. Berkeley: University of California Press.
- Berwick, R.C. (1982). *Locality principles and the acquisition of syntactic knowledge*. Thesis, Department of Electrical Engineering and Computer Science, MIT, Cambridge, Ma.
- Berwick, R.C. (1985). *The acquisition of syntactic knowledge*. Cambridge, MA: MIT Press.
- Bliss, T.V.P., & Errington, M.L. (1977). “Reeler” mutant mice fail to show spontaneous alternation. *Brain Research*, 124, 168–170.
- Blumberg, B.S., & Hesser, J.E. (1975). Anthropology and infectious disease. In A. Dawson (Ed.), *Physiological anthropology* pp. 260–294. New York: Oxford University Press.
- Bornstein, M.H. (1973). Color vision and color naming: A psychophysiological hypothesis. *Psychological Bulletin*, 80, 257–285.
- Bornstein, M.H. (1975). Qualities of color vision in infancy. *Journal of Experimental Child Psychology*, 19, 401–419.
- Bornstein, M.H. (1979). Perceptual development: Stability and change in feature perception. In M.H. Bornstein & W. Kessen (Eds.), *Psychological development from infancy: image to intention*. Hillsdale, NJ: Lawrence Erlbaum.
- Bornstein, M.H. (1981). Human infant color vision and color perception reviewed and reassessed: a critique of Werner and Wooten (1979a). *Infant Behavior and Development*, 4, 119–150.
- Bornstein, M.W., Kessen, W., & Weiskopf, S. (1976a). Color vision and hue categorization in young human infants. *Journal of Experimental Psychology and Human Perception and Performance*, 2, 115–129.
- Bornstein, M.H., Kessen, W., & Weiskopf, S. (1976b). The categories of hue in infancy. *Science*, 191, 201–202.
- Bornstein, M.H., & Marks, L.E. (1982). Color revisionism. *Psychology Today*, 16, 64–88, 68–70, 73.
- Bradshaw, G.F., Langley, P.W., & Simon, H.A. (1983). Studying scientific discovery by computer simulation. *Science*, 222, 971–975.
- Brillouin, L. (1962). *Science and information theory*. New York: Academic Press.

- Brunswick, E. (1956). *Perception and the representative design of experiments*. Berkeley: University of California Press.
- Caviness, V.S., Jr., & Rakic, P. (1978). Mechanisms of cortical development: A view from mutations in mice. *Annual Review of Neuroscience*, 1, 297–326.
- Chaitin, E. (1975). Randomness and mathematical proof. *Scientific American*, 232, 47–52.
- Chiva, M. (1979). Comment la personne se construit en mangeant. *Communications* (École des Hautes Études en Sciences Sociales–Centre d'Études Transdisciplinaires, Paris), 31, 107–118.
- Chomsky, N. (1980). *Rules and representations*. New York: Columbia University Press.
- Daly, M., & Wilson, M. (1978). *Sex, evolution and behavior*. North Scituate, MA: Duxbury Press.
- Dasen, P.R. (1972). Cross-cultural Piagetian research: A summary. *Journal of Cross-Cultural Psychology*, 3, 23–29.
- DeCasper, A.J., & Fifer, W.P. (1980). Of human bonding: Newborns prefer their mothers' voices. *Science*, 208, 1174–1176.
- Eibl-Eibesfeldt, I. (1979). Human ethology: Concepts and implications for the sciences of man. *The Behavioral and Brain Sciences*, 2, 1–57.
- Eilers, R.E., Wilson, W.R., & Moore, J.M. (1977). Developmental changes in speech discrimination in infants. *Journal of Speech and Hearing Research*, 20, 766–780.
- Eimas, P.D. (1985). The perception of speech in early infancy. *Scientific American*, 252, 46–52.
- Eimas, P.D., Siqueland, E.R., Jusczyk, P., & Vigorito, J. (1971). Speech perception in infants. *Science*, 171, 303–306.
- Fantz, R.L., Fagan III, J.F., & Miranda, S.B. (1975). Early visual selectivity: As a function of pattern variables, previous exposure, age from birth and conception, and expected cognitive deficit. In L.B. Cohen & P. Salapatek (Eds.), *Infant perception: From sensation to cognition: Basic visual processes*, Vol. 1 New York: Academic Press.
- Feldman, M.W., Cavalli-Sforza, L.L., & Peck, J.R. (1985). Gene-culture coevolution: Models for the evolution of altruism with cultural transmission. *Proceedings of the National Academy of Sciences of the United States of America*, 82, 5814–5818.
- Findlay, C.S., & Lumsden, C.J. (1986). The creative mind: Toward an evolutionary theory of discovery and innovation. *Journal of Social and Biological Structures*.
- Fodor, J.A. (1983). *The modularity of mind: An essay on faculty psychology*. Cambridge, MA: MIT Press.
- Fox, R., & McDaniel, C. (1982). The perception of biological motion by human infants. *Science*, 218, 486–487.
- Freedman, D.G. (1974). *Human infancy: An evolutionary perspective*. Hillsdale, NJ: Lawrence Erlbaum.
- Freeman, D. (1983). *Margaret Mead and Samoa: The making and unmaking of an anthropological myth*. Cambridge, MA: Harvard University Press.
- Gajdusek, D.C. (1970). Physiological and psychological characteristics of Stone Age man. *Science and Technology*, 33, 26–33, 56–62.

- Gardner, H. (1983). *Frames of mind*. New York: Basic Books.
- Gatlin, L.L. (1972). *Information theory and the living system*. New York: Columbia University Press.
- Geertz, C. (1984). "From the native's point of view": on the nature of anthropological understanding. In R.A. Schweder & R.A. LeVine (Eds.), *Culture theory essays on mind, self, and emotion*, New York: Cambridge University Press.
- Gleason, H.A. (1961). *An introduction to descriptive linguistics*. New York: Holt, Rinehart & Winston.
- Hallpike, C.R. (1979). *The foundations of primitive thought*. New York: Oxford University (Clarendon) Press.
- Hallpike, C.R. (1985). Social and biological evolution. I. Darwinism and social evolution. *Journal of Social and Biological Structures*, 8, 129–146.
- Hardy-Brown, K. (1983). Universals in individual differences: Disentangling two approaches to the study of language acquisition. *Developmental Psychology*, 19, 616–624.
- Harris, M. (1968). *The rise of anthropological theory: A history of theories of culture*. New York: Harper and Row.
- Hershenson, M., Munsinger, H., & Kessen, W. (1965). Preference for shapes of intermediate variability in the newborn human. *Science*, 147, 630–631.
- Hockett, C.F., & Ascher, R. (1964). The human revolution. *Current Anthropology*, 5, 135–147, 166–168.
- Holloway, R.L. (1966). Cranial capacity, neural organization, and hominid evolution: A search for more suitable parameters. *American Anthropologist*, 68, 103–121.
- Horton, D.L., & Mills, C.B. (1984). Human learning and memory. *Annual Review of Psychology*, 35, 361–394.
- Irons, W. (1979). Cultural and biological success. In N.A. Chagnon & W. Irons (Eds.), *Evolutionary biology and human social behavior: An anthropological perspective*. North Scituate, MA: Duxbury Press.
- Kagan, J. (1981). Universals in human development. In R.H. Monroe & B.B. Whiting (Eds.), *Handbook of cross-cultural human development*. New York: Garland.
- Kagan, J. (1984). *The nature of the child*. New York: Basic Books.
- Kay, P., & McDaniel, C.K. (1978). The linguistic significance of the meanings of basic color terms. *Language*, 54, 610–646.
- Keesing, R.M. (1976). *Cultural anthropology: A contemporary perspective*. New York: Holt, Rinehart and Winston.
- Keil, F.C. (1979). *Semantic and cognitive development: An ontological perspective*. Cambridge, MA: Harvard University Press.
- Keil, F.C. (1981). Constraints on knowledge and cognitive development. *Physiological Reviews*, 88, 197–227.
- Klaus, M.H., Jerauld, R., Kreger, N.C., McAlpine, W., Steffa, M., & Kennel, J.H. (1972). Maternal attachment: Importance of the first post-partum days. *New England Journal of Medicine*, 286, 460–463.
- Kroeber, A.L., & Kluckhohn, C. (1963). *Culture: A critical review of concepts and definitions*. New York: Random House.
- Laban, R. (1975). *Laban's principles of dance and movement notation* (2nd ed.). London: MacDonald and Evans.

- Land, E.H. (1983). Recent advances in retinex theory and some implications for cortical computations: Color vision and the natural image. *Proceedings of the National Academy of Sciences of the United States of America*, 80, 5163–5169.
- Larkin, J., McDermott, J., Simon, D.P., & Simon, H.A. (1980). Expert and novice performance in solving physics problems. *Science*, 208, 1335–1342.
- Lennie, P. (1984). Recent developments in the physiology of color vision. *Trends in Neurosciences*, 7, 243–248.
- Lerdahl, F., & Jackendoff, R. (1983). *A generative theory of tonal music*. Cambridge, MA: MIT Press.
- Levi-Strauss, C. (1969). *The elementary structures of kinship* (rev. ed.; J.H. Bell, Trans.; J.R. von Sturmer & R. Needham, Eds.). Boston: Beacon Press.
- Liberman, A.M., Cooper, F.S., Shankweiler, D.P., & Studdert-Kennedy, M. (1967). Perception of speech code. *Psychological Review*, 74, 431–461.
- Lisker, L., & Abramson, A.S. (1964). A cross-language study of voicing in initial stops: Acoustical measurements. *Word*, 20, 384–422.
- Lockhard, J.S., Daley, P.C., & Gunderson, V.M. (1979). Maternal and paternal differences in infant carry: U.S. and African data. *American Naturalist*, 113, 235–246.
- Loehlin, J.C., & Nichols, R.C. (1976). *Heredity, environment, and personality*. Austin, TX: University of Texas Press.
- Lumsden, C.J. (1985). Color categorization: A possible concordance between genes and culture. *Proceedings of the National Academy of Sciences of the United States of America*, 82: 5805–5808.
- Lumsden, C.J., & Gushurst, A. (1985). Gene-culture coevolution: Humankind in the making. In James H. Fetzer (Ed.), *Sociobiology and epistemology* (pp. 3–28). Boston: D. Reidel Publishing Co.
- Lumsden, C.J., & Wilson, E.O. (1981). *Genes, mind, and culture: The coevolutionary process*. Cambridge, MA: Harvard University Press.
- Lumsden, C.J., & Wilson, E.O. (1985). The relation between biological and cultural evolution. *Journal of Social and Biological Structures*, 8, 343–359.
- Maller, O., & Desor, J.A. (1974). Effect of taste on ingestion by human newborns. In J. Bosma (Ed.), *Fourth symposium on oral sensation and perception: Development in the fetus and infant*. Washington, DC: U.S. Government Printing Office.
- Markman, E.M., & Seibert, J. (1976). Classes and collections: Internal organization and resulting holistic properties. *Cognitive Psychology*, 8, 561–577.
- Marks, I.M. (1969). *Fears and phobias*. New York: Academic Press.
- Masui, S., & Lumsden, C.J. (1985). A mathematical approach to semantic network development. *Bulletin of Mathematical Biology*, 47, 629–650.
- Matsuzawa, T. (1985). Colour naming and classification in a chimpanzee (*Pan troglodytes*). *Journal of Human Evolution*, 14, 283–291.
- Maxwell, M. (1985). *Aesthetic feeling and the development of art: A case of gene-culture coevolution?* Report submitted in completion of the requirements for the Certificate of Advanced Study, Extension Division, Harvard University, Cambridge, MA.
- Mealey, L. (1985). The relation between social status and biological success: A case study of the Mormon religious hierarchy. *Ethology and Sociobiology*, 6, 249–257.

- Medin, D.L., & Smith, E.E. (1984). Concepts and concept formation. *Annual Review of Psychology*, 35, 113-138.
- Morgan, G.A., & Ricciuti, H.N. (1973). Infants' response to strangers during the first year. In L.J. Stone, H.T. Smith, & L.B. Murphy (Eds.), *The competent infant: Research and commentary*. New York: Basic Books.
- Murdock, G.P. (1967). Ethnographic atlas: A summary. *Ethnology*, 6, 109-236.
- Naroll, R., & Cohen, R. (Eds.). (1970). *A handbook of method in cultural anthropology*. Garden City, NY: The Natural History Press.
- Newell, A., & Simon, H.A. (1972). *Human problem solving*. Englewood Cliffs, NJ: Prentice-Hall.
- Pinker, S. (1981). What is language, that a child may learn it, and a child, that he may learn language? *Journal of Mathematical Psychology*, 23, 90-97.
- Plomin, R. (1983). Developmental behavioral genetics. *Child Development*, 54, 253-259.
- Posner, M.I., & Keele, S.W. (1968). On the genesis of abstract ideas. *Journal of Experimental Psychology*, 77: 353-363.
- Rakic, P. (1979). Genetic and epigenetic determinants of local neuronal circuits in the mammalian central nervous system. In F.O. Schmitt & F.G. Worden (Eds.), *The neurosciences: Fourth study program*. Cambridge, MA: MIT Press.
- Ratliff, F. (1976). On the psychophysiological basis of universal color terms. *Proceedings of the American Philosophical Society*, 120, 311-330.
- Rosch, E. (1973). Natural categories. *Cognitive Psychology*, 4, 328-350.
- Rosch, E. (1975). Universals and cultural specifics in human categorization. In R.W. Brishin, S. Bochner, & W.J. Lonner (Eds.), *Cross-cultural perspectives on learning*. New York: Halsted Press, Wiley.
- Rosch, E., Mervis, C.B., Gray, W.D., Johnson, D.M., & Boyes-Braem, P. (1976). Basic objects in natural categories. *Cognitive Psychology*, 8, 382-439.
- Rosenberg, A. (1980). *Sociobiology and the preemption of social science*. Baltimore: Johns Hopkins University Press.
- Salk, L. (1973). The role of the heartbeat in the relations between mother and infant. *Scientific American*, 228, 24-29.
- Sandell, J.H., Gross, C.G., & Bornstein, M.H. (1979). Color categories in macaques. *Journal of Comparative Physiological Psychology*, 93, 626-635.
- Seemonova, E. (1971). A study of children of incestuous matings. *Human Heredity*, 21, 108-128.
- Shannon, C.E. (1948). The mathematical theory of communication. *Bell System Technical Journal*, 27: 379-423, 623-656.
- Shepher, J. (1971). Mate selection among second-generation kibbutz adolescents and adults: Incest avoidance and negative imprinting. *Archives of Sexual Behavior*, 1, 293-307.
- Shepher, J. (1983). *Incest: A biosocial view*. New York: Academic Press.
- Simon, H.A. (1979). *Models of thought*. New Haven, CT: Yale University Press.
- Simon, H.A. (1981). *The sciences of the artificial* (2nd ed.). Cambridge, MA: MIT Press.
- Slobin, D.I. (1982). Universal and particular in the acquisition of language. In E. Warner & L.R. Glitman (Eds.), *Language acquisition: State of the art*. Cambridge: Cambridge University Press.
- Stern, C. (1973). *Principles of human genetics* (3rd ed.). New York: W.H. Freeman.

- Tobias, P.V. (1981). *The evolution of the human brain, intellect and spirit*. First Abbie Memorial Lecture, University of Adelaide, South Australia, October 12, 1979. Adelaide: University of Adelaide Information Office.
- van den Berghe, P.L. (1980). Royal incest and inclusive fitness. *American Ethnologist*, 7, 300–317.
- van den Berghe, P.L. (1983). Human inbreeding avoidance: Culture in nature. *The Behavioral and Brain Sciences*, 6, 91–123.
- van den Berghe, P.L., & Mesher, G.M. (1980). Royal incest and inclusive fitness. *American Ethnologist*, 7, 300–317.
- Waddington, C.H. (1957). *The strategy of the genes*. London: George Allen and Unwin.
- Weinberg, S.K. (1976). *Incest behavior* (rev. ed.). New York: Citadel Press.
- Wexler, K., & Culicover, P.W. (1980). *Formal principles of language acquisition*. Cambridge, MA: MIT Press.
- Whitfield, T.W.A. (1980). Salient features of color space. *Perception and Psychophysics*, 29, 87–90.
- Whorf, B.L. (1956). *Language, thought, and reality*. Cambridge, MA: MIT Press.
- Wickelgren, W.A. (1979). *Cognitive psychology*. Englewood Cliffs, NJ: Prentice Hall.
- Williams, T.R. (1972). *Introduction to socialization: Human culture transmitted*. St. Louis, MO.: C.V. Mosby.
- Wilson, E.O. (1975). *Sociobiology: The new synthesis*. Cambridge, MA: Belknap Press of the Harvard University Press.
- Wilson, E.O. (1978). *On human nature*. Cambridge, MA: Harvard University Press.
- Wilson, R.S (1978). Synchronies in mental development: An epigenetic perspective. *Science*, 202, 939–948.
- Witkowski, S.R., & Brown, C.H. (1977). An explanation for color nomenclature universals. *American Anthropologist*, 79, 50–57.
- Wolf, A.P. (1968). Adopt a daughter-in-law, marry a sister: A Chinese solution to the problem of incest taboo. *American Anthropologist*, 864–874.
- Wolf, A.P., & Huang, C.S. (1980). *Marriage and adoption in China, 1845–1945*. Stanford, CA: Stanford University Press.
- Zeki, S. (1983). Colour coding in the cerebral cortex: The reaction of cells in monkey visual cortex to wavelengths and colours. *Neuroscience*, 9, 741–765.

Part III

The Sociobiology of Parent–Child
Interactions

9

Research in Developmental Sociobiology: Parenting and Family Behavior

MARTIN S. SMITH

Developmental researchers agree that humans evolved through a process of natural selection. At least, few researchers publicly disagree with that position. However, contemporary developmentalists rarely consider the possible adaptive significance of the behavior they study, nor do they utilize evolutionary theory as a source of research hypotheses. There are several possible explanations for this. One is that most developmentalists are closet Creationists who are opposed to evolutionary explanation on theological grounds. Another is that, having carefully considered the implications of modern evolutionary theory for understanding the aspects of human development that they study, they have concluded that such implications are not discernible. A third possibility is that most developmental researchers simply are not aware of the relevance of evolutionary theory for the study of human development. I think the last possibility is most likely, and that as researchers become aware of how an evolutionary perspective can enrich the study of human development, we will see more research drawing on the insights of developmental sociobiology. This chapter reviews how evolutionary theory has recently been used to generate research hypotheses relevant to human parenting and family behavior. I will not review the concepts underlying developmental sociobiology. These are discussed in other chapters in this volume, as well as elsewhere (Alexander, 1979; Daly & Wilson, 1983; Smith, 1987a; Trivers, 1985). My goal here is to illustrate how principles of natural selection have been used to guide recent empirical research in order to encourage developmental researchers to become more knowledgeable about the evolutionary bases of human development.

Developmental researchers may have neglected evolutionary explanations because they may believe natural selection produced broad categories of behavior like sex and parenting, but that individual differences among people in these behaviors are determined by variation in the environments in which people are raised. However, contemporary evolutionary theory suggests that complex, highly social organisms like

humans evolved to modulate social behaviors like mating and parenting in response to specific environmental cues. The direction of these responses can be predicted from a knowledge of principles of natural selection together with an understanding of the environment in which most human evolution took place. The research reviewed here illustrates how such evolutionary predictions are generated and tested.

The research reviewed in this chapter is grouped into five topic areas: discriminative parental solicitude and child abuse; parental bereavement; kin recognition; adoption; grandparenting and inheritance; and parental effects on children's sexual development. These topics were chosen because at least one researcher or research group has conducted empirical research on them, or has presented some evolutionary hypotheses that have clear implications for research. In each case, I discuss the reasoning underlying the research hypotheses, summarize the empirical success of the hypotheses, and consider the implications of the study for future research.

Discriminative Parental Solicitude and Child Abuse

It is clear that humans evolved to be parental in some broad sense. Dispositions toward nurturing children are part of the human genotype in the same way that dispositions toward being sexual are. Yet most family researchers balk at going further than that. Apparently they are willing to accept the idea that evolution selected humans to be generally parental, but are unwilling to acknowledge that evolution may well have selected parents to be discriminating in their parental nurturance. The conventional view is that evolution produced a general tendency toward nurturing children, but that individual differences in parental behavior are attributable to environmental factors. So if Mr. Jones abuses one of his children, and Mr. Brown doesn't, the explanation must lie in the differing life experiences of Jones and Brown. Perhaps Jones's father beat him, and he is simply recapitulating that earlier experience with one of his own children. Or perhaps Jones was raised in a boarding school where corporal punishment was the rule, and that experience disposed him toward physically abusing children. The conventional view is that the answer must be sought in some environmental difference that altered the cognitive or emotional structures of Jones in such a way that physical abuse became part of his parenting repertoire.

Such factors undoubtedly play a major role in determining individual parenting styles. However, it is also possible that evolution shaped humans to change the way that they parent in response to particular environmental cues. For instance, people may have been designed with a tendency toward treating their own biological children better than unrelated children entrusted to their care. Such a disposition makes

evolutionary sense. Parents who lacked genetically encoded dispositions for such a preference might be less successful reproductively than those with such a disposition. This is because the nondiscriminating parents might spend some of their energy raising unrelated children, and since parental resources are limited, they would raise fewer biological offspring than discriminating parents, who concentrate their resources on their biological offspring.

Suggesting that discriminative parenting might contribute to reproductive success does not constitute evidence that such adaptations were actually selected. It does suggest the possibility, and provides a conceptual framework for generating testable predictions regarding the way parents would be expected to behave if such discriminative dispositions are indeed part of the human genotype. In a series of research reports, Martin Daly and Margo Wilson have presented evidence suggesting that human parents do discriminate among household members in a manner congruent with evolutionary predictions (Daly & Wilson, 1980, 1981a, 1981b, 1982a, 1982b, 1984, 1987a, 1987b; Wilson & Daly, 1987; Wilson, Daly, & Weghorst, 1980, 1981).

Daly and Wilson point out that we should not expect evolution to have selected human parents to invest equally in each child in their household. Parents are expected to favor children on the basis of their genetic relatedness and on their reproductive value. The first factor is relatively straightforward; people have likely evolved to invest more in children who are related to them than in those who are not. Therefore parents are expected to favor their own biological children over their genetically unrelated stepchildren. This prediction is confirmed in the data summarized in Daly and Wilson (1987b). Stepchildren are much more likely to be physically abused than are children living with two biological parents.

A second factor that is expected to modulate parental solicitude is reproductive value of the child. Reproductive value is an individual's probable future reproductive success. An infant's reproductive value is less than that of an adolescent, since there is a greater chance that the infant will die before reproducing than the adolescent. If forced to make a choice, parents who favored children with higher reproductive values would end up with more descendants. Therefore it is expected that humans may have been selected to show some such discrimination under conditions of scarce resources. Daly and Wilson found this to be the case, using infanticide as an extreme measure of parental discrimination. Biological parents were found to kill infants at a much higher rate than older children. (Daly & Wilson, 1984). Similarly, rates of child abuse and neglect are much higher among infants than among older children. Although there are alternatives to an evolutionary explanation of these findings, the pattern of data reported by Daly and Wilson accords well with the existence of evolved emotional dispositions

moderating parental solicitude according to the perceived fitness benefit to the parent.

Several cautions regarding this evolutionary view of discriminative parental solicitude should be made. If humans have evolved to value children within their households based on degree of relatedness and reproductive value, we would not necessarily expect parents to demonstrate strong preferences for one child over another in every instance where the parent's inclusive fitness might benefit by doing so. The hypothesized dispositions would be exactly that: tendencies that bias parental responses toward differential parenting patterns in some circumstances, but which would not inevitably result in noticeable asymmetries in parental feeling in all family situations. For instance, it is entirely possible that such dispositions would be expressed only in family situations where resources are severely limited, and hard choices must be made regarding what children will receive more resources. So one might expect such differential parenting patterns to be expressed more in large, poor families, or in families under stress for other reasons, where the emotional resources of the parents are more limited. Differential parenting dispositions might not be as often expressed in wealthier, smaller families, where emotional and economic resources are more plentiful, and parents can provide all of the children in their household with enough love and money for a solid foundation to successful reproductive careers.

Of course, these are generalizations, and it is likely that most stepparents in large, poor families do not abuse or neglect their stepchildren. Whether less extreme forms of discriminative solicitude occur in most of these stepparenting situations is an empirical question that has not been adequately addressed. However, to postulate that a disposition toward discriminative investment may be part of the human genotype is not to suggest that inadequate stepparenting is inevitable. It does suggest that we might expect to find a higher incidence of discriminative parenting among stepparents, in families where the reproductive values of siblings differ considerably, and in family situations that involve limited emotional and economic resources.

Such dispositions do not necessarily involve conscious motivations, such as stepparents making a rational calculation to withdraw resources from stepchildren in order to give their "own" children a better reproductive chance (although such conscious decision making would not be precluded by evolutionary reasoning). It is more likely that differential parenting is mediated by mechanisms that are more emotional than rational. Stepparents are expected to have a lower threshold of annoyance with stepchildren, and to more often "naturally" come to dislike stepchildren more often than they would biological children.

It might be argued that it is hard to see how a behavior like infanticide could possibly be advantageous to a stepparent's fitness, when it is

likely to lead to a jail term, dissolution of the pair-bond, and other outcomes that have a negative reproductive effect. The answer is twofold. First, behaviors like infanticide may represent the extreme end of a continuum of discrimination that includes many milder preferential activities such as biases in apportioning parental time, money, and food that might result in some benefit to the parent's inclusive fitness. Second, and more important, the emotional mechanisms underlying the system of discriminative parental solicitude are assumed to have been forged in a quite different social ecology than that of contemporary Western societies. It is possible that such differential parenting may have benefited parents' fitness in a hunting-gathering culture 2,000 years ago, but may not have that effect today. However, genotypes change very slowly, and we may be stuck with a parenting genotype that disposes toward discriminative parenting, even though such parenting may no longer benefit parents' fitness in modern society. So we should not expect parents and stepparents who discriminate among their children to have greater fitness in today's society than those who do not. In order to make the evolutionary hypothesis plausible, all we need is reason to believe that discriminative parenting might have benefited parents' fitness throughout much of our evolutionary past, and this is a reasonable assumption given our knowledge of the conditions of human evolution.

That natural selection may have shaped parents not to be unreservedly beneficent to all children within their household may seem to be a depressing suggestion, but infanticide, child abuse, child neglect, and parental preferences are social facts that demand explanation for both theoretical and practical reasons. If evolved dispositions toward discriminative parental solicitude do play a role in child abuse, as Daly and Wilson suggest, then we are doing a disservice to future victims of child abuse by not carefully considering this possibility in our theoretical models and societal interventions.

Daly and Wilson do not claim that genotypic discriminatory mechanisms by themselves explain most of the variance in child abuse and infanticide. Obviously, environmental factors like socioeconomic level, family constellation, family size, societal parenting customs, and societal sanctions against child abuse interact with evolved parenting dispositions to produce the range of parenting outcomes that we see in our societies. Evolutionary explanation should not be seen as replacing more environmental explanations of parenting behavior, but as providing another level of explanation to complement existing multilevel models (e.g., Parke & Lewis, 1981).

Daly and Wilson's research on patterns of child abuse and neglect provides an exemplar of how evolutionary reasoning can be used to illuminate aspects of human development. They started by predicting how we might expect humans to have evolved if natural selection indeed acted to produce parents who were attempting to optimize their

inclusive fitness, and these predictions were in clear, testable form. Appropriate measures of the behavior in question were decided upon, and data were collected. Some relevant data were available in archival crime and social statistics collections, but extensive data recording and analysis were necessary in order to address the research hypotheses. Alternative measures and data collection procedures were also used in later studies. In general, the data from all studies supported the research hypotheses. The data were used to address alternative hypotheses, and inconsistencies were explored. Finally, shortcomings in the data base were examined and suggestions for future research offered.

In nonexperimental research of this type, one can never decide with complete certainty that a hypothesized explanation is correct. All a researcher can do is provide evidence that increases the plausibility of an explanation and that decreases the plausibility of competing explanations. If someone thinks they know with absolute certainty that evolutionary dispositions toward discriminative parenting have nothing to do with child abuse, Daly and Wilson's data would not change their mind. However, the reasoning and evidence assembled by Daly and Wilson should intrigue and challenge any researcher interested in understanding the roots of human parenting behavior. If Daly and Wilson are correct, they are dealing with issues that are central to our understanding of the roots of human parenting, and particularly to the *psychology* of parenting. They offer novel explanations for why human parents feel the way they do toward their children, rooted in the guiding paradigm of the biological sciences: evolutionary theory.

Parental Bereavement

Christine Littlefield and J. Phillippe Rushton recently reported a study of parental bereavement that followed a logic of testing predictions drawn from evolutionary theory similar to the research of Daly and Wilson. If parental bereavement was influenced by the system of discriminative parental solicitude postulated by Daly and Wilson, then parent's grief following the death of a child might be related to the child's potential reproductive value to the parent. Littlefield and Rushton (1986) formulated 10 predictions regarding the pattern of bereavement expected if the deceased child's reproductive value to the parent was a factor in determining intensity of grief. The rationale for four of these predictions is summarized here.

Prediction 2 was that parents would grieve more for healthy children than for unhealthy children. Healthy children would generally contribute more to their parent's inclusive fitness than unhealthy children.

Prediction 5 was that a parent would grieve more for a child perceived as being more similar to that parent. Although each child receives 50%

of his genes from each parent, this is a minimum figure for the number of genes identical by descent that each child shares with each parent, and it is possible that a parent could share more genes in common with one child than with others. It has therefore been suggested that natural selection may have shaped parents (as well as individuals in other social relationships) to attempt to assess genetic similarities using rules of thumb such as phenotypic resemblance, and to modulate altruistic behavior in accordance with such estimated genetic commonality (see section on kin recognition below; see also Rushton, Russell, & Wells, 1984). A parent was expected to grieve more for a child who was perceived as more similar to the parent because more of the parent's genes were estimated as being lost than with a child who was less similar to the parent.

Prediction 6 was that older children will be grieved for more intensely than younger children. This is because the reproductive value of older children is greater, primarily due to the lesser chance of their dying before reproducing.

Prediction 7 was that older parents would grieve more intensely than younger parents. This was because the older parents would have fewer opportunities to reproduce in the future, thus the death of a child represented a greater decrement to the inclusive fitness of older parents than younger parents.

Littlefield and Rushton tested these predictions by collecting Bereavement Questionnaires from 263 individuals who had experienced the death of a child. The respondents were asked to judge their grief and that of other family members on a 7-point scale that ranged from no grief (1) to total devastation (7).

Prediction 2 was confirmed. Parents grieved more for healthy children than unhealthy ones. Prediction 5 was confirmed: parents grieved more for children perceived as resembling their side of the family. The results for Prediction 6 were equivocal; although there was no relationship between the children's age and the intensity of parent's grief with unadjusted data, when the age of parents was controlled in a partial correlation, there was a modest significant correlation between children's age and intensity of parent's grief, with parents grieving slightly more for older children. Prediction 7 was *not* confirmed; in fact, after controlling for the age of the child, older parents were found to grieve slightly *less* than younger parents, contrary to the prediction.

Overall, Littlefield and Rushton found support for 7 of their 10 predictions, and failed to confirm 3 of the 10, including Predictions 6 and 7 discussed above. They conclude that the pattern of results demonstrate strong support for the sociobiological perspective. This illustrates an important point: The success of individual predictions derived from evolutionary theory is not as important as the overall pattern of results obtained in a study, or, better yet, over a number of studies. It is to be

expected that the premises underlying some individual predictions are incorrect, and that those predictions will fail to be confirmed. However, if most predictions derived from the evolutionary perspective fail to be confirmed, or if other perspectives can be shown to better explain the results, then developmental sociobiology is in trouble. However, at this point, predictions about human parenting patterns derived from evolutionary theory have proved to be a generally accurate guide to the real world of behavior within human families.

Kin Recognition

If we did evolve to distribute resources among conspecifics in a way that optimizes our inclusive fitness, it would have been adaptive to evolve mechanisms that enabled us to discriminate relatives from nonkin, and perhaps even to determine degrees of relatedness among family members. It is clear that many animal species discriminate kin from nonkin, and researchers distinguish three possible categories of kin recognition mechanisms that might be based on recognition of distinctive features of relatives: association/familiarity, phenotype matching, and recognition alleles (Porter, 1987).

Kin recognition by association/familiarity simply means that individuals evolved to assess relatedness according to how familiar a given conspecific is. And of course familiarity is directly proportional to degree of association. Therefore, individuals would behave most altruistically toward conspecifics whom they have spent the most time with, and would behave least altruistically toward unfamiliar conspecifics. Because in many species, individuals spend most of their time during their early development in constant association with close kin such as parents and siblings, association/familiarity would be a very good indication of the number of genes identical by descent shared by any given pair of conspecifics. If individuals in these species followed the rule of thumb "Behave altruistically toward conspecifics in proportion to your degree of past association with them," they would generally end up allocating their resources in a way that optimized their inclusive fitness.

Kin recognition based on association/familiarity would work very well in most human societies, and this is the primary mechanism for kin recognition in humans. Our strongest emotional bonds are with those conspecifics whom we have spent the most time with in intimate settings; generally our parents and siblings, then other relatives such as grandparents, uncles, aunts, and cousins. Strong and enduring emotional bonds with nonrelatives are rarer than those with relatives, and generally develop only with individuals with whom we have had the opportunity for continuing, intimate interactions.

It is possible that association/familiarity is the only kin recognition mechanism that natural selection built into the human genotype. However it is also possible that other mechanisms, such as phenotype matching operate as well. Phenotype matching is a process whereby an organism creates a composite mental template of particular phenotypic features characteristic of the individual in his rearing environment, and then compares unfamiliar conspecifics to the template. The degree of similarity between the unfamiliar individual and the family template influences the degree of altruism demonstrated in subsequent interactions. It is possible, for instance, that early in childhood, we create a facial template derived from the facial features of the members of our nuclear family, and we unconsciously compare new acquaintances with that template, with our subsequent feelings for them being influenced by this comparison. Little research has examined the possibility of such phenotype matching in humans, and the investigation of this topic should be high on the research agenda of developmental sociobiology.

A third possible mechanism for kin recognition involves hypothetical recognition alleles: genes that would code for the construction of a distinctive phenotypic trait, and would also influence individuals to be altruistic toward conspecifics who manifest that trait. Richard Dawkins (1976) refers to this as a Green Beard effect, and uses the example of a gene that would cause an individual both to grow a green beard, and to be altruistic toward individuals who have a green beard. Note how this mechanism differs from phenotype matching. Recognition alleles would work even if the individual had never seen his relatives; the recognition template for the green beard would not require exposure to familial phenotypes during rearing in order to develop. Although the possibility of recognition alleles has only begun to be investigated in animals, there is currently no firm evidence that such a mechanism actually exists in any species. Nevertheless, J.P. Rushton and colleagues have argued that kin recognition alleles are likely to play a much greater role in human social relationships than is generally acknowledged (Rushton & Russell, 1985; Rushton et al., 1984, 1985; Russell, Wells, & Rushton, 1985). They present a number of predictions generated by "genetic similarity theory," and discuss relevant evidence. Although Rushton and colleagues depart from the current sociobiological consensus regarding the likely influence of kin recognition alleles, they suggest several potentially profitable directions for empirical research, and this research should help determine the relative influence of genetic similarity detection and association/familiarity in human social development.

Whether association/familiarity is the only nonrational kin recognition mechanism used by humans, or whether other mechanisms also evolved as part of our genotype, it is clear that the formation of

emotional bonds within the human family follows a species-specific ontogeny that will be further illuminated by evolutionary perspective. Of course, developmental researchers have been investigating the formation of emotional bonds within human families for some time. For instance, John Bowlby's classic research on the growth of attachment bonds between mothers and children has added considerably to our understanding of the natural history of emotional bonding within human families. Bowlby (1969) synthesized an ethological-evolutionary perspective together with psychodynamic and Piagetian constructs relevant to attachment behavior. However, the continued refinement of evolutionary theory in the last two decades provides some insights into attachment behavior and kin recognition that were unavailable to Bowlby when he began to formulate his theory in the 1950s and 1960s. This is exemplified in the research of Richard Porter, who has recently investigated some aspects of human kin recognition from an evolutionary perspective (Cernoch & Porter, 1985; Porter, 1987; Porter, Cernoch, & Balogh, 1984; Porter, Cernoch & Balogh, 1985; Porter, Cernoch & McLaughlin, 1983; Porter & Laney, 1980; Porter & Moore, 1981).

Porter's research addresses the question of how—and how early—do mothers come to discriminate their infants from other children? In one study, Porter and his colleagues (1984) found that mothers with only a few hours postnatal contact with their newborn infants were able to discriminate a photograph of their child's face from photos of three unrelated infants. This is evidence that a prolonged period of association is evidently not necessary for kin recognition to be effective in the mother-child relationship. One third of these mothers mentioned their child's perceived resemblance to other family members, such as fathers or siblings, as a factor in the mother's successful identification, which raises the possibility that phenotype matching may be a factor in this early recognition.

To determine whether newborn infants actually do have a discernible resemblance to kin, Porter et al. (1984) asked adult subjects to match photographs of newborns with those of several recent mothers, including the baby's real mother. Although performance was not perfect, subjects performed at a better than chance level in this task, indicating that there is a degree of actual similarity in the facial features of newborn humans and close kin, thus providing some potential cues for phenotype matching to operate.

To separate the effects of familiarity/association from those of phenotype matching, it would be useful to test the ability to discriminate one's own offspring with mothers who had little or no opportunity to interact with their newborns prior to testing. Correct identification of neonates under these circumstances would likely be due to phenotype matching rather than association. Porter et al. (1983) conducted such a study, using as their subjects recently parturient mothers who had delivered

by Caesarian section. These mothers had very little opportunity to become familiar with their infants prior to recognition testing, which took place within the first two days postpartum. The phenotypic cue to recognition tested in this study differed from the one described above; instead of seeing if mothers could recognize their infants' faces, the researchers examined whether mothers could differentiate the odor of their baby from those of unrelated children. Mothers sniffed containers holding the shirts worn by their babies, and were asked to pick out the smell of their baby from those of other infants. A significant proportion of the mothers could do so, even though they had had an average of less than three hours of contact with the baby prior to testing. Again, some mothers mentioned the similarity between their baby's odor and that of other family members as an important cue.

In a more recent study, Porter et al. (1985) found that unrelated subjects can also identify mother-child pairs by smell alone. Subjects were able to successfully match the odor of clothes worn by mothers with the odors of their 3- to 8-year-old children, thus demonstrating that family resemblances in odor are also discernible by strangers.

Porter (1987) raises several issues for future research into human kin recognition to consider. It is possible that fathers may utilize a somewhat different blend of kin recognition mechanisms than mothers, for two reasons. Fathers interact far less with their infants and children than mothers do, thereby providing a less extensive foundation for association/familiarity. Furthermore, because of paternal uncertainty, there is always a chance that a putative father actually is not the biological father of his spouse's child. This means that fathers, more than mothers, may have been selected to depend on phenotype matching of the newborn child with members of *his* family, to be used as a guide to kin recognition and subsequent parental solicitude. Porter also points out that it is possible that conditions that decrease phenotypic similarity between parents and children, such as children's facial deformities, may interfere with kin recognition mechanisms, and might therefore influence the development of parent-child bonds. He suggests that mismatches between the phenotypes of adoptive parents and their unrelated children might create similar problems, and points out that phenotypic dissimilarity might be one of the proximal cues leading to the increased incidence of child abuse in stepparenting situations pointed out by Daly and Wilson (1984).

Adoption

From an evolutionary perspective, adoption of unrelated children seems puzzling. Why was there not powerful selection against parenting dispositions that allows humans to gain enormous emotional satisfaction

from caring for unrelated children, as adoptive parents? While this situation has been beneficial from a humanitarian point of view, it seems odd that more psychological barriers to adoption did not evolve, since adoption would seem to decrease the inclusive fitness of adoptive parents compared to parents who did not adopt.

A number of researchers have examined the evolutionary conundrum that adoption presents (e.g., Alcock, 1984; Alexander, 1979; Barash, 1982; Daly & Wilson, 1983; Silk, 1980), but I will focus here on John Alcock's discussion, because it has particularly clear implications for stimulating research. Alcock (1984) outlines two possible evolutionary explanations for adoption. One is that adoption is an evolutionary nonadaptive byproduct of the usually adaptive disposition to care for children in your environment. Alcock labels this the *misplaced parental care* hypothesis, and suggests that it generates the testable prediction that people who cannot produce children themselves should be more likely to adopt than fertile individuals. The rationale here is that we evolved to want to care for our own biological children, but if that is not possible, we still desire the satisfaction of parenthood, and will search for unrelated children to satisfy that longing. A second prediction is that if adoptive parents have their own biological children after adopting an unrelated child, they will tend to favor their biological children.

The second type of evolutionary explanation that Alcock discusses is that adoption occurs today only because the present social ecology differs so radically from the environment in which humans evolved. This argument suggests that there may have been little opportunity to adopt unrelated young in a natural environment, and therefore there was no opportunity for selection against such behavior to occur. This suggestion assumes that for much of our existence as a species, we have lived in social environments that were composed of individuals who were related to some degree. For much of our evolutionary past, humans evidently lived in small groups of hunter-gatherers, and the level of relatedness within the groups would have been quite high. Even neighboring groups would likely contain kin such as cousins, nephews, and nieces. Under these circumstances, any children without parents would likely be related to most of the other group members, and there would be an inclusive fitness increment to an adult relative who adopted a parentless child, as long as the resources expended on the adopted child did not detract from the fitness of the adopter's biological children. In these circumstances, a general disposition to prefer one's own children but also to nurture needy children in the larger group if resources permit would be adaptive. However the expression of such a disposition in a contemporary Western environment, where most needy children in the environment would not be related to potential adopters, would result in the generally satisfactory adoption of many children by adults who were unrelated to them.

Although not mentioned by Alcock, one prediction that might stem from this explanation of adoption is that potential adoptees might prefer to adopt related children instead of unrelated ones. Another prediction deriving from this explanation would be that people feel more strongly compelled to adopt needy children the more closely related the children are to them. These analyses of adoption are important because they demonstrate that a behavior that superficially appears to be puzzling from an evolutionary perspective can, on further analysis, turn out to be fully comprehensible as a product of evolution. Indeed, such an analysis may, as in the case of adoption, produce testable predictions that further our understanding of developmental sociobiology.

Grandparenting and Inheritance

To this point this review has focused on the evolutionary bases of human parenting behavior. However, inclusive fitness theory also suggests that we evolved to invest in other kin as well as children, and I investigated patterns of grandparental kin investment in a recent study (Smith, 1987b). Evolutionary reasoning suggests that the ultimate reason grandparents enjoy, nurture, and protect their grandchildren is because grandparents share, on average, 25% of their genes identical by descent with each grandchild. However, some putative grandparents may not share any genes with their ostensible grandchildren for the same reason that father can never be completely confident of their parentage: paternal uncertainty. There is always a possibility that a man is not the father of his putative offspring, and paternal uncertainty may have been an important selective force in human evolution. For instance, perhaps it influenced males, more than females, to utilize phenotype matching as a cue to kin investment, as discussed above.

Grandparental investment might also be affected by paternal uncertainty insofar as the grandparental relationship involves two generational links where paternal uncertainty might play a role. On the basis of this reasoning, I made three predictions regarding grandparental investment in grandchildren. First, grandmothers should invest more in grandchildren than grandfathers, because of the uncertain link between grandfathers and their children. Second, both grandmothers and grandfathers should invest more in their daughters' children than in their sons' children. Finally, the first two predictions were combined to produce a more complex prediction. Grandparental investment should follow the order: (1) maternal grandmothers, (2) maternal grandfathers and paternal grandmothers, (3) paternal grandfathers. This is because the maternal grandmother relationship involves no uncertain male links, the paternal grandfather situation involves two such uncertain links, and the other two grandparental relationships each involve one certain and one uncertain link.

To test these predictions, grandparents were asked to fill out a questionnaire regarding how much time they spent with each of their grandchildren. Although kin investment can be measured in many other ways, as illustrated in the research reviewed in previous sections, time spent with grandchildren was used as the measure in this study because it is finite, easily measured, and grandparents must make choices regarding how they apportion their visiting time among their offspring's families. Responses from 587 grandparents were used in the analysis after excluding cases that detracted from a clearer test of the predictions, such as grandparents who lived in the same residence as their grandchildren, or those with divorced or separated children.

Regarding the first prediction, grandmothers did spend 18% more time with their grandchildren than did grandfathers, but this difference was both smaller than expected and was not statistically significant, perhaps partly due to the large variance in the amounts of grandchild visiting time reported. Grandparents did spend 37% more time with their daughters' children than with their sons' children; thus the second prediction was confirmed. The third prediction was also confirmed; maternal grandmothers spent almost twice as much time with their grandchildren as did paternal grandfathers, and the other two groups were intermediate.

Thus two of the three predictions were unambiguously confirmed, including the most important one (Prediction 3), while there was a statistical trend in favor of the first prediction. Nonetheless, the question of why the difference between grandmothers and grandfathers was less than expected (certainly less than the difference between the time mothers and fathers spend with their children) leads to a consideration of how we might expect sex-differentiated patterns of kin investment to develop and change over a person's lifetime (Smith, 1987b). In brief, grandfathers should be expected to spend less time with their grandchildren than grandmothers only if they have any other alternatives for increasing their inclusive fitness. If not, they should invest as much of their "investable" time and energy in their grandchildren as grandmothers do, even if, because of paternal uncertainty, their payoff in inclusive fitness for doing so will be slightly less, on average, than the payoff for grandchildren. A reasonable bet is better than no bet at all, even if it is not as good as a sure bet.

The ambiguous outcome of one of these predictions led to a reconsideration of the original theoretical premises, thereby suggesting the possibility of intriguing developmental sex differences in kin investment patterns. This illustrates that the failure of a prediction can be even more valuable than the validation of one, when such a failure leads to elaboration or correction of some aspect of the theory that generated the prediction. This is, of course, exactly the kind of productive interaction between theory and data that the hypothesis-testing approach to research is expected to facilitate.

The results of this study can, of course, be interpreted in nonevolutionary terms, and even if the observed patterns are influenced by kin investment dispositions, the mechanisms of such influence are unclear. For instance, do grandparents simply prefer their daughter's children because they are their daughter's children? Or is phenotype matching involved? Do grandparents assess their grandchildren's resemblance to themselves, and then develop preferences according to those perceived similarities? To examine how evolved dispositions and cultural influences work together to produce the patterns reported here requires future research using more sophisticated measures. But these are researchable, empirical questions, and this preliminary investigation provides reason to believe that further research into the sociobiology of the extended family is warranted.

Another way of measuring kin investment is to examine how much money family members give each other. Like time, money is a finite resource that will often increase the reproduction of the recipient, and it is reasonable to assume that reproductive considerations play some role in determining how money is transferred within families. Because everyone who makes out a will must decide precisely who will receive his/her financial resources, some colleagues and I examined several predictions regarding the inheritance patterns we expected if people were indeed attempting to turn their money into babies (Smith, Kish, & Crawford, 1987). We predicted that people would leave more of their estates to close relatives than to distant relatives or nonrelatives. Unsurprisingly, this prediction was confirmed when we examined 1,000 probated wills. We also predicted that in deciding between categories of kin who were equally closely related, willmakers would favor the group with the highest reproductive value. Thus offspring should be favored over siblings, even though the average percentage of common genes is the same in both relationships: 50%. This prediction was also confirmed. The most interesting prediction was that wealthier decedents would favor sons, and the less wealthy would favor daughters. The rationale for this prediction was suggested by Trivers and Willard (1973). In species where males can increase their fitness substantially by acquiring more than one mate, the males who are most successful reproductively will outreproduce their sisters. Therefore resources that the parents invest in their sons in that situation will pay off in more grandchildren than if the same resources were invested in daughters. However, the flip side is that if offspring are likely to be below average reproductively (because of poor health, few resources, poor territory, etc.), daughters are a better bet, because they are likely to have at least a few offspring, whereas an uncompetitive male in a polygynous society is likely not to have any offspring at all (Hrdy 1987).

Humans evolved in societies where polygyny was an option for the most successful males; therefore it is possible that a resource-contingent allocation of parental resources between sons and daughters may have

been selected to be part of human parenting psychology. Our data support that possibility. Wealthier decedents did leave more money to their sons, and the poorer ones left more to their daughters. Among the wealthiest quartile of decedents (with estates greater than \$111,000), twice as much was left to sons as to daughters, whereas among the poorest quartile of decedents, (estates less than \$20,000) twice as much was left to daughters as to sons. The two quartiles intermediate in wealth (estates between \$20,000 and 110,000) showed no preference. Again, nonevolutionary factors may influence these patterns of inheritance, but these results provide further evidence that a number of aspects of our interactions with kin may reflect dispositions toward optimizing inclusive fitness that were shaped during our millions of years as hunter-gatherers.

The dispositions hypothesized in this study are assumed to be facultative: that is, the behavior of the organism is expected to vary in different environmental circumstances. If parents find themselves below average for their society in resources, status, or health, they are expected to favor daughters. If their circumstances changed suddenly for the better, sons should be favored. It is important to note the difference between this kind of flexible, environmentally influenced disposition and the rigid, immutable “instincts” social scientists sometimes appear to believe sociobiologists are postulating. Although it is unlikely that nature selected humans to be infinitely plastic, there is good reason to believe that some adaptive flexibility was built into our evolved dispositions.

Parental Effects on Children's Sexual Development

There are other ways that parents can influence the reproduction of their offspring apart from investing time and resources in them. For instance, it might be adaptive if parents could influence their children's sexual development, including mating strategies and timing of reproduction. In fact, it has been suggested that parents in some species may have evolved to attempt to influence the reproductive behavior of their offspring in a way that might serve the reproductive interests of the parent more than those of the offspring. This is a theoretical possibility because although parents and offspring in diploid species like humans share 50% of their genes by common descent, they do not share the other 50% by common descent, and their reproductive interests diverge somewhat because of this. Alexander (1974) suggests that in many species, parents are able to “manipulate” individual offspring in a way that increases the fitness of the parent at the expense of the offspring. Examples are parents that cannibalize some of their brood in order to invest in other offspring, or that render some of their offspring sterile so that all of the reproductive energies of these sterile individuals will be directed toward caring for their siblings.

Whether or not any form of evolved parental manipulation occurs among humans has not been investigated. However, it has been suggested that humans may have evolved so that as children we are particularly influenced by our parent's pair-bonding arrangements, and this influence is expressed in adolescence in different developmental "tracks" for sexual and mating behavior. Draper and Harpending (1982; this vol., Chap. 12) contend that the presence or absence of a father in the household during childhood is the key factor in this system. They suggest that girls from father-absent homes will engage in sexual activity earlier, and will form less stable pair-bonds. This is because the perception they formed during childhood was that males are not expected to contribute to child care, and there is therefore no reproductive advantage to be gained by carefully choosing an advantageous mate and postponing reproduction. In contrast, girls from father-present homes are expected to perceive that male parental investment is an essential component in optimum reproduction, and therefore will postpone early sexual activity, will invest more time and energy in locating a suitable mate, and will form more stable pair-bonds. A similar developmental divergence is also suggested for males. Draper and Harpending cite as evidence for their contention research by Hetherington (1972) that reported that adolescent girls from homes where the parents were divorced were rated as being more sexually active on several measures, as compared to girls from two-parent families.

Draper and Harpending's suggestion is speculative, and needs further empirical examination. However, a recent finding by Surbey (1987a) fits well into the Draper and Harpending hypothesis. Surbey found that girls from father-absent homes entered menarche an average of six months earlier than girls from father-present homes. Although Draper and Harpending did not suggest that the presence or absence of a father would affect girls' physical development, Surbey's finding could certainly be interpreted as support for their model. Surbey's data suggest that the presence of a father in the home may not only affect children's psychological development, but may have a significant effect on their physical development as well. Such social influences on physiological events have been well documented in the animal literature (Drickamer, 1974; Vandenberg, 1969) and some effects have previously been reported in humans (McClintock, 1971). However, Surbey's finding is one of the first reports of family constellation affecting human physical development.

Conclusions

The studies reviewed here demonstrate that contemporary evolutionary theory has stimulated considerable empirical research aimed at increasing our understanding of human development. Developmental

sociobiology can hardly be characterized as armchair speculation, given the research energies expended in collecting substantial data sets on topics as wide-ranging as child abuse through inheritance patterns to age of puberty. Nor can the evolutionary explanations presented be dismissed as post hoc. More often than is typical of developmental research, the studies reviewed here involved formulating hypotheses prior to collecting data, and then reexamining and refining theory in light of the success or failure of the predictions. Although this process of hypothesis testing might not ultimately be the most productive model for testing theory in the social sciences (Greenwald, Leippe, Pratkanis, & Baumgardner, 1986), its use in these studies indicates that evolutionary theory is *not* a vague paradigm of little relevance for understanding specifics of human thought and emotion. Rather, it is a generally accepted set of principles regarding how natural selection operates to shape the morphology and behavior of organisms. These principles recently have been refined to the point where they can generate testable predictions regarding central aspects of human development.

This review is not a comprehensive synthesis of recent research in developmental sociobiology. There are many other researchers whose data and ideas make important contributions to the area (e.g., Blurton-Jones, 1982, 1983; Blurton-Jones & Sibly, 1978; Dickemann, 1979a, 1979b, 1981, 1983), and some of this work is discussed in other chapters in this volume, and in Crawford, Smith, and Krebs (1987). Although this review has focused on parental behavior, the evolutionary perspective can probably illuminate other aspects of human development, such as developmental psychopathology. The first steps in this direction are apparent in the work of researchers such as deCatanzaro (1981, 1987) on suicide and Surbey (1987b) on anorexia nervosa. Most developmental sociobiology has focused on socioemotional development, with little consideration of cognitive development. This is not surprising, given that it may be easier to envisage the reproductive consequences of alternative forms of social behavior than cognitive traits. It is also easier to measure variation in most social traits. However, this is not to say that developmental sociobiology has nothing to say about cognitive development. Lumsden (1983; this vol., Chap. 8) suggests that evolution selected particular epigenetic rules governing human cognitive preferences, and points to some possibilities for empirically investigating the developmental expression of these cognitive structures. Nevertheless, empirical research in developmental sociobiology to date has focused on socioemotional development, and particularly on familial relationships. Although evolutionary reasoning can help understand nonfamily relationships, such as relationships with peers, the emphasis in inclusive fitness theory on relatedness makes contemporary evolutionary theory particularly important for providing insights into the growth of kin-related feelings.

It must be emphasized that evolutionary explanation does not necessarily contradict other explanations of developmental phenomena. It may be that some researchers resist exploring the implications of developmental sociobiology for their topics because they feel evolutionary explanation is necessarily opposed to learning, cultural, psychodynamic, or other explanations. Although in some areas this may be the case, in general evolutionary explanation complements more proximal perspectives, while providing unique explanations of some otherwise inexplicable or unnoticed phenomena. Adopting an evolutionary perspective does not mean abandoning other perspectives; it means enlarging them. For instance, MacDonald (1984) discusses how evolutionary theory and social learning theory can be mutually enriching, and Leak and Christopher (1982) examine the relationship between Freudian and evolutionary thinking.

Sociobiology has not yet had a major impact on research and theory in developmental psychology. This is not surprising, given that many of the key explanatory concepts have emerged within the last 15 years and that most of the empirical research reviewed in this article has taken place within the last 5 years. As researchers in human development become more familiar with contemporary evolutionary reasoning, we can expect a steady increase in empirical studies in developmental sociobiology, and we will probably also see more models of human developmental processes incorporating evolutionary explanation. Developmentalists have traditionally been interested in the biological roots of human behavior (Baldwin, 1894, cited in Braughton, 1981; Piaget, 1978), and the explanatory power of contemporary evolutionary theory will likely prove irresistible to many active developmental scientists who are searching for tools to help them understand the complexities of human development.

REFERENCES

- Alcock, J. (1984). *Animal behavior: An evolutionary approach*. Sunderland, MA.: Sinauer.
- Alexander, R.D. (1974). The evolution of social behavior. *Annual Review of Ecology and Systematics*, 5, 325-384.
- Alexander, R.D. (1979). *Darwinism and human affairs*. Seattle: University of Washington Press.
- Baldwin, J.M. (1894). *Mental development in the child and the race*. New York: Macmillan.
- Barash, D.P. (1982). *Sociobiology and behavior* (2nd ed.). New York: Elsevier.
- Blurton-Jones, N.B. (1982). Origins, functions, development, and motivation: Unity and disunity in the study of behavior. *Journal of Anthropological Research*, 38, 333-349.
- Blurton-Jones, N.G. (1983). Two investigations of human behavior guided by evolutionary theory. In G.C.L. Davey (Ed.), *Animal models of human behavior*. New York: John Wiley.

- Blurton-Jones, N.G., & Sibly, R.M. (1978). Testing adaptiveness of culturally determined behaviour: Do bushman women maximize their reproductive success by spacing births widely and foraging seldom? In N.G. Blurton-Jones & V. Reynolds (Eds.), *Human behaviour and adaptation*. London: Taylor and Francis.
- Bowlby, J. (1969). Attachment and loss (Vols. 1 and 2). New York: Basic Books.
- Broughton, J.M. (1981). The genetic psychology of James Mark Baldwin *American Psychologist*, 36, 396–407.
- Cernoch, J.M., & Porter, R. (1985). Recognition of maternal axillary odors by infants. *Child Development*, 56, 1593–1598.
- Crawford, C.B., Smith, M.S., & Krebs, D. (Eds.). (1987). *Sociobiology and psychology: Ideas, issues and applications*. Hillsdale, NJ: Lawrence Erlbaum Associates.
- Daly, M., & Wilson, M. (1980). Discriminative parental solicitude: A biological perspective. *Journal of Marriage and the Family*, 42, 277–288.
- Daly, M., & Wilson, M. (1981a). Abuse and neglect of children in evolutionary perspective. In R.D. Alexander & D.W. Tinkle (Eds.), *Natural selection and social behavior*. New York: Chiron Press.
- Daly, M., & Wilson, M. (1981b). Child maltreatment from a sociobiological perspective. *New Directions for Child Development*, 11, 93–112.
- Daly, M., & Wilson, M. (1982a). Homicide and kinship. *American Anthropologist*, 84, 372–378.
- Daly, M., & Wilson, M. (1982b). Who are newborn babies said to resemble? *Ethology and Sociobiology*, 3, 69–78.
- Daly, M., & Wilson, M. (1983). *Sex, evolution and behavior* (2nd ed.). Boston: Willard Grant Press.
- Daly, M., & Wilson, M. (1984). A sociobiological analysis of human infanticide. In G. Hausfater & S.B. Hrdy (Eds.), *Infanticide: Comparative and evolutionary perspectives*. New York: Aldine.
- Daly, M., & Wilson, M. (1987a). Evolutionary psychology and family violence. In C.B. Crawford, M.S. Smith, & D. Krebs (Eds.), *Sociobiology and psychology: Ideas, issues and applications*. Hillsdale, NJ: Lawrence Erlbaum Associates.
- Daly, M., & Wilson, M. (1987b). Children as homicide victims. In R. Gelles & J. Lancaster (Eds.), *Offspring abuse and neglect in biosocial perspective*. New York: Aldine.
- Dawkins, R. (1976). *The selfish gene*. New York: Oxford University Press.
- deCatanzaro, D. (1981). *Suicide and self-damaging behavior: A sociobiological perspective*. New York: Academic Press.
- deCatanzaro, D. (1987). Evolutionary pressures and limits to self-preservation. In C.B. Crawford, M.S. Smith, & D. Krebs (Eds.), *Sociobiology and psychology: Ideas, issues and applications*. Hillsdale, NJ: Lawrence Erlbaum Associates.
- Dickemann, M. (1979a). Female infanticide, reproductive strategies, and social stratification: A preliminary model. In N. Chagnon & W. Irons (Eds.), *Evolutionary biology and human social behavior: An anthropological perspective*. North Scituate, MA: Duxbury.
- Dickemann, M. (1979b). The ecology of mating systems in hypergynous dowry societies. *Social Science Information*, 18, pp. 163–195.
- Dickemann, M. (1981). Paternal confidence and dowry competition: A biocultural analysis of purdah. In R.D. Alexander & D.W. Tinkle (Eds.), *Natural*

- selection and social behavior: Recent research and new theory*. New York: Chiron.
- Dickemann, M. (1983, May). Female choice, male life histories and male celibacy in U.S. Black ghettos. In R.M. Wiegell & N.G. Blurton-Jones (Organizers), *Application of Life History Strategies Models to the Study of Human Development*. Workshop conducted at University of California, Los Angeles.
- Draper, P., & Harpending, H. (1982). Father absence and reproductive strategy: An evolutionary perspective. *Journal of Anthropological Research*, 38, 255-273.
- Drickamer, L.C. (1974). Contact stimulation, androgenized females and accelerated sexual maturation in female mice. *Behavioral Biology*, 12: 101-110.
- Greenwald, A.G., Pratkanis, A.R., Leippe, M.R., & Baumgardner, M.H. (1986). Under what conditions does theory obstruct research progress? *Psychological Review*, 93, 216-229.
- Hetherington, E.M. (1972). Effects of father absence on personality development in adolescent daughters. *Developmental Psychology*, 7, 313-326.
- Hrdy, S.B. (1987). Sex-biased parental investment among primates and other mammals: A critical evaluation of the Trivers-Willard hypothesis. In R. Gelles & J. Lancaster (Eds.), *Offspring abuse and neglect in biosocial perspective*. New York: Aldine.
- Leak, G.K., & Christopher, S.B. (1982). Freudian psychoanalysis and sociobiology: A synthesis. *American Psychologist*, 37, 313-322.
- Littlefield, C.H., & Rushton, J.P. (1986). When a child dies: The sociobiology of bereavement. *Journal of Personality and Social Psychology*, 51, 797-802.
- Lumsden, C.J. (1983). Gene-culture linkages and the developing mind. In C.J. Brainerd (Ed.), *Recent advances in cognitive-developmental theory*. New York: Springer-Verlag.
- MacDonald, K. (1984). An ethological-social learning theory of the development of altruism: Implications for human sociobiology. *Ethology and Sociobiology*, 5, 97-110.
- McClintock, M.K. (1971). Menstrual synchrony and suppression. *Nature*, 229, 244-245.
- Parke, R., & Lewis, N.G. (1981). The family in context: A multilevel interactional model of child abuse. In R.W. Henderson (Ed.), *Parent-child interaction: Theory, research and prospects*. New York: Academic Press.
- Piaget, J. (1978). *Behavior and evolution*. New York: Pantheon.
- Porter, R. (1987). Kin recognition: Functions and mediating mechanisms. In C.B. Crawford, M.S. Smith, & D. Krebs (Eds.), *Sociobiology and psychology: Ideas, issues and applications*. Hillsdale, NJ: Lawrence Erlbaum Associates.
- Porter, R., Cernoch, J.M., & Balogh, R.D. (1984). Recognition of neonates by facial-visual characteristics. *Pediatrics*, 74, 501-504.
- Porter, R., Cernoch, J.M., & Balogh, R.D. (1985). Odor signatures and kin recognition. *Physiology and Behavior*, 34, 445-448.
- Porter, R., Cernoch, J.M., & McLaughlin, F.J. (1983). Maternal recognition of neonates through olfactory cues. *Physiology and Behavior*, 30, 151-154.
- Porter, R.H., & Laney, M.D. (1980). Attachment theory and the concept of inclusive fitness. *Merrill-Palmer Quarterly*, 26, 35-51.

- Porter, R., & Moore, J.D. (1981). Human kin recognition by olfactory cues. *Physiology and Behavior*, 27, 493-495.
- Rushton, J.P., & Russell, R.J.H. (1985). Genetic similarity theory: A reply to Mealey and new evidence. *Behavior Genetics*, 15, 575-582.
- Rushton, J.P., Russell, R.J.H., & Wells, P.A. (1984). Genetic similarity theory: Beyond kin selection. *Behavior Genetics*, 14, 179-193.
- Rushton, J.P., Russell, R.J.H., & Wells, P.A. (1985). Personality and genetic similarity theory. *Journal of Social and Biological Structures*, 8, 63-86.
- Russell, R.J.H., Wells, P.A., & Rushton, J.P. (1985). Evidence for genetic similarity theory in human marriage. *Ethology and Sociobiology*, 6, 183-187.
- Silk, J. (1980). Adoption and kinship in Oceania. *American Anthropologist*, 82, 799-820.
- Smith, M.S. (1987a). Evolution and developmental psychology: Toward a sociobiology of human development. In C.B. Crawford, M.S. Smith & D. Krebs (Eds.), *Sociobiology and psychology: Ideas, issues and applications*. Hillsdale, NJ: Lawrence Erlbaum Associates.
- Smith, M.S. (1987b). *Grandparenting as kin investment*. Unpublished manuscript.
- Smith, M.S., Kish, B.J., & Crawford, C.B. (1987). Inheritance of wealth as human kin investment. *Ethology and Sociobiology*, 8, 171-182.
- Surbey, M.K. (1987a). Father absence and the timing of menarche. Unpublished manuscript.
- Surbey, M.K. (1987b). Anorexia nervosa, amenorrhea and adaptation. *Ethology and Sociobiology*, 8, 47S-61S.
- Trivers, R.L. (1985). *Social evolution*. Menlo Park, CA: Benjamin/Cummings.
- Trivers, R.L., & Willard, D.E. (1973). Natural selection of parental ability to vary the sex ratio of offspring. *Science*, 179, 90-92.
- Vandenbergh, J.G. (1969). Male odor accelerates female sexual maturation in mice. *Endocrinology*, 81:345.
- Wilson, M., & Daly, M. (1987). Risk of maltreatment of children living with step-parents. In R. Gelles & J. Lancaster (Eds.), *Offspring abuse and neglect in biosocial perspective*. New York: Aldine.
- Wilson, M., Daly, M., & Weghorst, S.J. (1980). Household composition and the risk of child abuse and neglect. *Journal of Biosocial Science*, 12, 333-340.
- Wilson, M., Daly, M., & Weghorst, S.J. (1981). Differential maltreatment of girls and boys. *Victimology*, 6, 249-261.

10

Ultimate and Proximate Determinants of Child Maltreatment: Natural Selection, Ecological Instability, and Coercive Interpersonal Contingencies

ROBERT L. BURGESS, JEFFREY A. KURLAND,
and EMILY E. PENSKY

Introduction: Alternative Perspectives of Child Maltreatment

For most people, the family is assumed to function as Christopher Lasch (1977) aphoristically summarizes: a “haven in a heartless world.” However, research over the past 25 years indicates that Doris Lessing (1973) may have been the more perceptive observer when she wrote that “Behind every door there is a disaster.” Cumulative research findings indicate that the family is often a storm center marked by disaffection, disengagement, conflict, aggression, and violence. In this chapter, we shall attempt to provide some theoretical coherence to the multitude of attempts that have been made to explain violence and other forms of harmful mistreatment directed toward children in their homes.

This task is made difficult because there are potential ambiguities in the use of concepts such as abuse, violence, and aggression. The term *aggression* is most often used to refer to acts that are intended to harm another. The harm intended can be psychological, social, physical, or material. Following the lead of Gelles and Straus (1979, p. 554) the concept of violence, as we will use it, is equivalent to physical aggression: “an act carried out with the intention of, or perceived as having the intention of, physically hurting another person.” The harm produced can range from the minor pain produced by a slap all the way to murder.

Gelles and Straus (1979) provide a useful discussion of the theories that have been used to explain violence in families. These theories differ in terms of the units of analysis employed as well as in terms of the causal mechanisms that are emphasized. For example, theories focusing on the individual have emphasized mechanisms as seemingly diverse as the intrapsychic processes of Freudian theory to the consequences of goal interference in frustration–aggression theory. Theories focusing on interaction have emphasized mechanisms as apparently different as the

interpersonal contingencies of reinforcement and punishment found in behavior theory to the importance of self and other attributions found in symbolic interaction theory. Finally, there are theories that focus on sociocultural mechanisms such as norms, values, and the role of the ecology in which a family finds itself. Their discussion of these various theories is cogent and fairly comprehensive and we shall not duplicate their earlier effort here.

We take as our starting point the premise that these putatively competing theories are not competitors in a theoretical contest but rather co-players that have simply directed their attention to different manifestations of the phenomenon in question. Moreover, from our perspective, these theories often operate at different levels of theoretical abstraction. Thus, we first discuss what appear to be the most general theoretical propositions currently available to us. We will bring in lower level theoretical observations where appropriate.

There is another way in which these different theoretical approaches may be contrasted apart from their fundamental units of analysis and levels of abstraction. Some approaches have focused largely on what medical researchers refer to as *marker variables* whereas others emphasize causal mechanisms or processes (Burgess, 1986). Marker variables simply tell us where to look for probable causal processes. Examples of such marker variables include social class, underemployment, poor neighborhoods, social isolation, family size, alcoholism, depression, and low self-esteem. These and other factors have been found to be reliably associated with the maltreatment of children, but they do not in and of themselves explain why or how it is that some and only some people with such characteristics express violent behavior.

The most important problem facing us is to identify the causal mechanisms that connect precipitating conditions to actual physical violence and to explain why conflicts of interest appear to be so common in family relations. For these reasons, our discussion departs from the usual social science approach in that we consider child abuse in modern post-industrial society in two larger contexts: (1) concepts and issues now current in evolutionary biology, and (2) data from cross-cultural studies of family relations (Burgess & Draper, in press). The long history of violence across species and cultures has led us to the conclusion that we clearly need theoretical propositions that derive from a broadly historical perspective, that transcend interspecific differences, and that are sufficiently general to permit parsimonious interpretations of the diverse data currently available, yet precise enough to generate specific predictions. We shall argue that modern evolutionary theory meets these criteria. Our belief is that knowledge of the evolutionary and ecological factors associated with the relationship between parents and offspring can reveal much about parent-offspring conflict (e.g., Trivers, 1974).

Data drawn from cross-cultural studies illustrate that relations between parents and offspring show a great deal more variability than

is apparent to social scientists whose field of analysis is limited to complex, stratified Western societies. For example, when seen from our current moral values, behaviors such as child abuse appear to be profoundly pathological. However, our values are entrenched in a stable, centralized political system and an economy which distributes huge surpluses with a surprising degree of equity among individuals who are no longer connected to each other by long-standing ties of shared residence and kinship. Humans have not long experienced the geographical mobility, affluence, and political stability of our current society. Indeed, the industrial revolution and the biomedical advances which reduce mortality are only recent embellishments on earlier inventions which have had even more profound consequences for the human social condition. Because of the rapidity of technological advance and the geometric increase in the world population in the last few hundred years, we find it easy to forget that social relationships, including family relationships, were structured in significantly different ways from those to which we have now become accustomed.

Throughout most of history, the individual's "rights" to life and some measure of satisfaction were a function of being born into an established group based on ties of kinship. This preexisting group provided economic and political security for new members; it also was a buffer against other similarly structured groups which, depending upon circumstances, could constitute a serious competitive threat. For our ancestors, families or kindreds were a necessity for survival and reproduction (van den Berghe, 1979). In order to maintain a competitive advantage or to expand against the interests of other groups, families (particularly their senior members) had to be able to allocate resources efficiently among kin and other individuals related by marriage. Our point is that families both nurtured members and culled among them. Ample examples come from European traditions in the form of primogeniture, sending surplus children into monasteries and convents, "selling" children into indentured servitude and apprenticing children for periods of years to nonfamily members (Dickemann, 1979). In other, more final ways, parents discriminated among children, keeping some and "letting go" of others by recourse to distant wet nurses in the notorious rural baby farms of 17th and 18th century Europe (Aries, 1970; De Mause, 1974; Langer, 1972).

We mention these recent practices (which seem abhorrent by modern standards) because we will be making the point frequently that human family relationships cannot be assumed to be inevitably benign. Competition for access to scarce resources is a fact between families and within families (Trivers, 1974). It is in this context that the cross-cultural record is most valuable. We have good ethnographic descriptions of societies ranging from technologically simple hunter-gatherers, through tribal economies based on horticulture and animal husbandry, to peasant intensive-land-use systems. All human societies provide a

normative system within which mating, parenting, and ties of kinship develop. By looking at diverse societies, one can see the interplay between individual behavior, family goals, environment, and social institutions. Broadening one's understanding of family interaction by looking at different cultural settings has many advantages. In particular, one can analyze how human universals such as sex, age, competition/hierarchy, and biological kinship constitute a core around which human families operate. At the same time, one can determine how extrafamilial and nonbiological factors such as environment, climate, population density, and the economy affect the expression of these underlying universals.

Evolutionary Theory and Learning Rules

To set our argument into the proper evolutionary context, we should like to draw the reader's attention to the major concepts of evolutionary theory. These concepts will be used to construct the most general theoretical propositions for our analysis of child maltreatment.

Evolutionary theory assumes that all of life from the beginning of time has been subjected to a continual process of *natural selection*, i.e., *differential reproductive success*. An individual's evolutionary fitness is defined in terms of reproductive success relative to others. On average, individuals better adapted to their physical and social environment have higher fitness. Individuals continually affect one another's fitness in that they compete for as well as create resources which, necessarily, are finite (Williams, 1966). Fitness, i.e., *inclusive fitness*, can sometimes be facilitated by behaving altruistically toward genetically related others. There is evidence that most animals have evolved to be altruistic especially towards their genetic relatives, i.e., members of their kin group (Alexander, 1979a,b). We maintain that many of the behaviors we associate with family life, including the tendency to produce and care for offspring, to establish relatively enduring social-emotional bonds, to mourn the loss of loved ones, and even to exhibit violent behavior toward family members, can ultimately be explained in terms of the contributions those behaviors make to inclusive fitness. We should perhaps emphasize our use of the adverb *ultimately* in the preceding sentence. A complete explanation of a behavior also requires attention to potential causal mechanisms and we will have occasion throughout this chapter to refer to important proximate processes that have originated in other theoretical perspectives.

It is a common part of the parlance in evolutionary ecology to describe patterns of behavior as *strategies*, for example, reproductive, life-historical, or foraging strategies. This is a convenient metaphor meant to emphasize the nonrandom and goal-directed aspects of alternative

behavioral processes. It is not therefore assumed that the individual displaying such a "strategy" is either conscious of its goals and mechanisms to such ends or cognitively deciding the best course of action. On the other hand, some behavioral strategies may well necessitate more cognition than had been initially assumed (e.g., Cheney, Seyfarth, & Smith, 1986). Although the ultimate goal of behavioral strategies is assumed to be increased inclusive fitness, each strategic analysis seeks to explicate more immediate, proximate goals such as time minimization, energy maximization, increased access to members of the opposite sex, etc. (see review in Krebs & Davies, 1987).

A concept from evolutionary theory that is central to our understanding of child maltreatment is the concept of *parental investment* (Trivers, 1972). Parental investment refers technically to behavior displayed by a parent that increases the reproductive potential of the child toward whom the behavior is directed, at the cost of similar investment by the parent toward other or future offspring. Implicit in the definition is the notion that a parent has limited resources and a finite lifespan to expend those resources in the rearing of children. Another key concept we will use is *parental certainty* (Kurland & Gaulin, 1984). Because females have virtually complete certainty of parenthood, whereas males do not, we will be especially concerned with the concept of *paternity certainty*. This concept from evolutionary theory is central to an understanding of family organization and process, including parental investment.

Our intention in this chapter, then, is to use evolutionary reasoning and arguments about evolutionary fitness to try to make sense of the often puzzling phenomenon of child maltreatment. We fully recognize that this is not an easy task, in part because many of the central concepts are difficult to operationalize. Fitness, for example, is the touchstone of evolutionary biology and yet it is difficult to measure or operationalize (Wallace, 1958). Here we will use success in reproduction, i.e., completed fertility, as an index of evolutionary fitness.

Some of the controversy surrounding our approach stems from the old and, in our opinion, sterile debate about "nature and nurture" or "heredity and environment" in the human sciences. Yet, when the domain of discussion passes from the general to that of specific problems, issues, or phenomena in the behavioral sciences, there is not substantial disagreement to be found among working scientists. Variation in human behavioral development is the product of nurture, but the way that an organism transforms environmental signals into behavioral phenotypes is the result of its evolutionary history (see e.g., reviews in Alcock, 1984; Bateson, 1982; and Dawkins, 1982).

One of our goals, thus, is to elucidate learning rules, evolutionary algorithms which mediate between the environment, broadly defined, and an organism's response to it. For example, rats learn easily to avoid

foodstuffs that lead to nausea but they find it difficult to learn to avoid foods that result in electric shock (Garcia & Koelling, 1976). Rats learn food avoidance, yet the learning rule used is a sensible consequence of their evolutionary past: avoiding food with peculiar taste and odor because these are indicative of tainted food. Individuals in the past who avoided such tainted or rotten foods were likely to avoid poisonous or sickening substances that would either kill or debilitate and therefore were better able to survive to reproduce. Learning is not an arbitrary concatenation of cue and reward, but is itself shaped by the evolution of adaptive sensory, motor, and cognitive physiology.

Another factor that contributes to the controversy of applying evolutionary theory to human behavior is the assumption that the theory seems to imply that all behavior must be adaptive. However, the theory suggests something quite different. It suggests, first of all, that many, but not necessarily all, attributes (behavioral as well as morphological), evolved because they contributed to reproductive success in previous species-typical historical circumstances. Thus, evolutionary biologists often act as historians attempting to determine why a particular trait might have been adaptive (Alexander, 1979b). Second, the theory allows for the fact that some attributes may simply be by-products or incidental consequences, i.e., nonadaptations of other attributes that were the product of selection pressures. Third, the theory does not rule out the possibility that some attributes are actually maladaptive. The theory would, of course, lead to the prediction that truly maladaptive traits would eventually be selected against precisely because they interfere with reproductive success.

Our attempt to use evolutionary theory to explain the maltreatment of children does not assume that maltreatment is necessarily adaptive for anyone. Rather, we shall argue that the apparently nonrandom pattern of child abuse suggests that discriminatory parental behavior has been adaptive in certain past environments (Lightcap, Kurland, & Burgess, 1982; Daly & Wilson, 1980). The major point here is that nonadaptive and maladaptive behaviors may be grounded in an underlying evolutionary logic. Thus, even pathological behaviors may allow tests of evolutionary hypotheses in that they may, in effect, make more apparent the constitutional, circumstantial, psychological, and developmental factors associate with the behavior under analysis (Symons, 1979, 1986). Therefore, we are prepared to argue that violence in some family contexts has been a part of the repertoire of behaviors of our ancestors. But, we also suggest that violence is elicited easily by certain environmental conditions and that the way humans perceive their environment is an evolved characteristic worthy of investigation in those terms.

Our evolutionary model assumes that

- Humans have learning rules and perceptual rules.

- These are best understood at this stage in the development of behavioral science as products of our evolution.
- These are neither always nor even usually adaptive in contemporary environments.
- These are not necessarily “conscious” or accessible to introspection by the actors.

Evolution, Reproduction, and Ecology

Any evolutionarily successful organism must balance its allocation of time, energy, risk, and other resources to growth and maintenance (somatic effort), on the one hand, and to mating and parenting (reproductive effort), on the other hand (Pianka, 1970; Kurland & Gaulin, 1984; Daly & Wilson, 1983). Organisms adapted to transient resources or unstable environments, where selection will favor prolific breeders who can momentarily take advantage of an open niche, will make the greatest genetic contribution to the next generation. Such organisms are referred to as *r-strategists*, in that they manifest traits associated with a high *r*, the intrinsic rate of increase of a population conforming to the logistic growth equation. On the other hand, there are *K-strategists* who evolve traits that are associated with alterations in the maximum population size that can be accommodated by the organisms interacting with the environment, that is, the “carrying capacity” of logistic population growth, symbolized by *K*. Although *r*-strategists are expected to have a large number of cheaply produced progeny who will opportunistically settle new habitats, the *K*-strategists are expected to invest heavily in each offspring making them “durable” and competitive in stable and saturated environments. From our perspective, the key distinction between *r*- and *K*-strategists is the low parental effort of the former, and the relatively higher parental effort of the latter. The terms are relative, so that, for example, the dandelions in your yard are *r*-strategists compared to your apple tree, but are *K*-strategists when compared to the prodigious masting output of a chestnut oak. Among mammals, primates are relatively *K*-strategists, but among the primates, humans are rather extreme *K*-strategists, although, given the current human population explosion, our closest living animal relative, the chimpanzee, is even more of a *K*-strategist than we are. In any case, the *r*-*K*-strategy continuum of life-historical and reproductive traits underscores the constellation of mating and parenting tactics of humans:

- Immaturity is very prolonged. Humans require 15 to 25 years to reach reproductive maturity.
- Parental care in humans is prolonged. It lasts from approximately 2 to 30 or so years in various human societies. This is almost an order of magnitude longer than for other mammals.

- Extensive learning is necessary for successful survival and reproduction.
- Males provision and otherwise provide resources for females and dependent offspring. There is a great deal of variation in the amount of parental effort by fathers across human societies, but there is almost always some.

These consequences are obviously interrelated. We list them to emphasize the unprecedented place that parental provisioning, nurture, and, especially, the teaching of immature young have in our species. Humans are evolved specialists in child raising and child care. But as one would predict, there is a dark side to this specialization. Individuals who spent their resources on either offspring of low viability or, worse, immatures who were not their own, left few descendants. We expect, then, highly evolved and specific learning rules and perceptual algorithms for adaptive human parenting.

It has become increasingly apparent in evolutionary ecology that mating systems are related to species characteristics, habitat, resource distribution, and the ease with which resources can be stored or defended (Kleiman, 1977; Kleiman & Malcolm, 1981; Wittenberger, 1980; Vehrencamp & Bradbury, 1984). The key issue in unraveling the associations among these factors is offspring survival. Under some circumstances, females can rear young without direct provisioning from males, for example, where resources can be independently harvested by her. Another is where pressure from predators can be handled by her alone or by associating with other females in protective herds or burrows. In these situations, males may facilitate offspring survival in an indirect manner, as in the case of territorial defense, which ensures the female and her brood the ability to gather food and/or to birth young without intense competition from conspecifics. Most mammals have mating systems of this type.

In other cases, where the sexes form durable pair bonds, it is thought that the paternal role in protecting offspring evolved because it promoted male fitness. According to current evolutionary thinking, high male parental investment cannot evolve (or be "facultatively" expressed) except where benefits to males outweigh costs in terms of forgone mating opportunities (Zeveloff & Boyce, 1980; reviewed in Kurland & Gaulin, 1984). In mammals, the extreme inequality of reproductive investment by the sexes rewards competition by males for access to multiple mates; for this reason monogamy is rare in mammals. The (infrequent) occurrence of monogamy among mammals is explained in terms of species morphology, characteristics of young, and distribution of resources such that the fitness interests of both the male and female are best served by combining efforts in the form of establishing an exclusive mating relationship, cooperating in nest-building or home-territory defense, and in rearing of young.

Because of the anatomy and physiology of reproduction in mammals, there are asymmetries between the sexes in the amount of time, energy, and risk devoted to reproduction (Dawkins, 1982; Trivers, 1972; Kurland & Gaulin, 1984). Mammalian physiology requires at minimum almost no parental investment from males, while females must commit a lot. This asymmetry of parental investment leads to sex differences in patterns, or "strategies," of reproductive behavior. Unlike the male, whose reproductive success may be furthered by impregnating as many females as possible, the female's reproductive success is limited by the time, energy, and risk costs of ovulation, conception, successful parturition, and, in the case of altricial (relatively helpless) young, the constraints of nurturing her offspring until they can survive on their own. Given a lower ceiling on female reproductive potential, females of most mammalian species should and indeed do show greater discrimination regarding mate choice and timing of reproduction than is shown by males and greater commitment to parental effort.

Males can vary their commitment of resources between the extremes of maximizing copulation with a large number of females, the "cad strategy," and maximizing provision of parental care to their offspring, the "dad strategy" (Draper & Harpending, 1982). Among mammals, the empirical correlates of the cad strategy are male dominance hierarchies, male-male aggression and violence, and high morphological dimorphism between the sexes because, in this situation, the fitness of a male seems to be determined primarily by competition with other males. Well-known examples of species with cad mating organization are elephant seals (LeBouef, 1974), anubis baboons on the savannah (DeVore, 1963), and most herd ungulates. In contrast, when male parental effort is high, the empirical correlates for numerous species are: relatively stable, male-female monogamous associations, reduced male-male competition for access to females, and reduced dimorphism. Familiar examples include gibbons, beavers, mongoose, and wolves in some areas (Kurland & Gaulin, 1984).

There is a corresponding strategy spectrum for females. In the face of males who will not provide parental effort, females may maximize reproductive success by minimizing time loss. They then reproduce early, with little or no concern for their mate or mates. Hrdy (1981) suggests that in many social species, selection has favored outright promiscuity in females, confusing paternity of offspring, and thus defusing tendencies in males to harm or kill infants (their putative offspring) in the future. At any rate, with her larger reproductive commitment and her limited reproductive potential, female investment in each offspring ought to be greater relative to that of the male, and this is in fact what is observed (Trivers, 1972, 1985).

In populations where there are males willing to invest heavily in offspring, females may delay sexual bonding and refuse any male except

for one who will be a reliable partner and provisioner for her and the offspring of the mating. These abilities allow her to avoid pregnancy without a stable mate and assure the mate that he is in fact the father of offspring born (Trivers, 1972). In species where such a cautious reproductive style is practiced, there is considerable courtship prior to mating. The female tests the qualities of the male as a potential mate, and the male assures himself during the same period that the female is not already pregnant by some other male.

This perspective from the evolutionary ecology of mating and parenting can be usefully applied to social processes in humans (Burgess & Draper, *in press*). In the case of humans, of course, simple knowledge of habitat characteristics does not produce much predictive power because humans remain morphologically quite generalized and “specialize” behaviorally in a variety of adaptive ways (Washburn, 1978). For humans, technology is one critical variable that intervenes between themselves and their local environment. Humans, insofar as cultural mores go, do not uniformly adhere to monogamous mating practices. Indeed, if pre-, extra-, and post-marital sex are added, as well as divorce and remarriage, concubineage, prostitution, etc., it becomes apparent that humans are, and have long been, effectively polygamous or serially monogamous. Marital polygyny is more common among the ethnographically described human societies than is monogamy (van den Berghe, 1979).

Just as we find variation in mating and marriage across societies and cultures, so too, are there variations in parenting practices. For example, although male parental investment is normatively expressed in all known societies, it varies on the individual level from males who show virtually no parental involvement after insemination to males who provide direct nurturance lasting well into adulthood. It is our view that ecological conditions affect human reproductive (mating and parenting) effort in important ways. We explore two ecological conditions in this chapter: cultural norms and the stability or instability of the environment in which families find themselves.

Cultural Norms and Child Maltreatment

In discussing cultural norms that differentially influence parental effort, including the maltreatment of children, we must recognize that customs which seem clearly harmful to children are often benign from the parents' perspectives; they are simply following practices that form a part of the traditional ways in which a child becomes a member of the social group. Cassidy (1980), for example, has used the concept of “benign neglect” to emphasize that many weaning customs of nonindustrialized people potentiate malnutrition. Ethnographic studies indicate

that there are many customs that contribute to the malnutrition and associated secondary infections of children. Some parenting customs do this indirectly by permitting or encouraging caretakers and toddlers to engage in interpersonal relationships that exacerbate the psychological stress associated with weaning, or directly by permitting or encouraging the imposition of dietary restrictions and food competition between age and sex groups (Cassidy, 1980).

Looking first at the stress connected to weaning, in many societies the child is abruptly weaned from the mother's breast. Events surrounding this change in the mother-child relationship include forcible separation of toddler and mother and punishment for the expression of dependency behaviors. The mother may put bitter substances on her nipples, slap her child, burn its arms with caustic plant juice, ignore its cries, etc. (Levine & Levine, 1963). The point is that many societies have customs that exacerbate the psychological stress of weaning, including the promotion of the maternal deprivation syndrome. Symptoms following such deprivation include insomnia, anorexia, weight loss, increased susceptibility to infection, even death (Bowlby, 1951; Rohner, 1975).

Food competition takes many different forms. In some societies, a newly weaned toddler is expected to compete on an equal basis with older siblings and even adults. In Malaya, for example, parents attribute independence and responsibility to young children and explain their extreme thinness by simply saying the child "refuses to eat" (Wolff, 1965). Wolff attributes high toddler malnutrition and mortality to these practices. In many societies, it is common for toddlers to receive a disproportionately small share of total family food because the traditional food-flow patterns favor adults, especially economically productive males (e.g., Cuthbertson, 1967). It should be noted that these dietary practices usually assume certain predictable patterns. For example, in most societies, the weaning customs favor males (Cassidy, 1980). Importantly, the child who is weaned later is less at risk of malnourishment.

A number of different theoretical approaches have generated explanations of these fairly common practices. It has been suggested, for example, that the experience of malnutrition in early childhood may be biologically adaptive because it biases developmental plasticity toward hunger-resistance in societies where food is often scarce. It has been found that individuals from societies where malnutrition is common grow more slowly, are shorter, and generally require less food (Newman, 1961). Thus, in this case, long-term advantage may accrue despite the short-term damage of malnutrition. Another explanation one finds in the literature is that toddler malnutrition and associated higher mortality rates function as population control mechanisms because they remove individuals from the population directly by causing their death (Scrimshaw, Taylor, & Gordon, 1968). This is perhaps best seen in cases where preferential treatment (better or more nutritious foods and

delayed weaning) is given to males. Given the "normally" higher mortality rate of male children, such special favors may serve the function of creating adaptive sex ratios (Fisher, 1958; Trivers, 1985), without implying unlikely group-selection mechanisms (Williams, 1966).

Were we to witness similar behavior in our own society, we would probably explain it as being due either to "ignorance" of appropriate child rearing techniques or to an underlying lack of affection. To be sure, pre-scientific conceptions are often at odds with the recent discoveries of Western scientific medicine. Moreover, there is some evidence that as parents become more educated, the use of traditional methods declines as does the frequency of malnutrition (Sanjur, Cranoito, Rosales, & von-Veen, 1970).

Concerning the "lack of affection" explanation, most of the ethnographic literature reports that parents in nonindustrialized societies are generally nurturant and affectionate with their children (Cassidy, 1980). Moreover, apparent parental rejection may in some societies be common yet not culturally preferred. For example, given a history of malnourishment for both mother and child, a cycle of unresponsiveness may develop where mother and child display progressively deteriorating behavior patterns. Children of malnourished mothers are found to be of lower birth weight, they demonstrate lower resistance to infection, and are less responsive to maternal stimulation. By being less responsive, these children may fail to signal their needs to their mothers (Pollitt, 1973).

In a study of 101 societies reported in the Human Relations Area Files, Rohner (1975) finds that both affection and rejection occur in all societies. He suggests a cultural continuum. At one extreme are societies with child care customs that primarily emphasize affection (e.g., Papago) and at the other are those that emphasize rejection (e.g., Ik). But, perhaps most importantly, Rohner distinguishes between rejection that is relatively constant, generalized, and expected to have major maladaptive effects on child development, from sporadic, short-term rejection that is associated with specific events of child rearing. He calls the latter form of occasional rejection *molecular*: molecular rejection occurs in settings that otherwise emphasize affection. This concept is important because it illustrates that neglect can simply be a technique for socialization rather than a global parental attitude and tactic indicating disinterest or hostility toward a child.

One interesting feature of harmful dietary and weaning customs is that they exemplify the fact that cultural practices can interpose time and space between actions that are harmful and a child's actual death. Because of this, the relationship between cause and effect can be circuitous and not apparent. For example, systematically denying children access to protein-rich food may produce subclinical malnutrition which may weaken them so that they fall victim to severe diarrhea. Gastro-

intestinal disease and dehydration will be recorded as the cause of death, not the predisposing malnutrition and food practices due to parental neglect. Similarly, severe infection of ritually inflicted wounds associated with puberty rites may appear several days later resulting in death, especially when ashes or other substances are rubbed into the wounds for desired cosmetic effects (Linton, 1936). Scrimshaw (1984) notes that seeking psychological distance through temporal and spatial distance occurs even among infanticidal parents who often abandon rather than directly murder their children.

There is a considerable amount of evidence that progenicide (action that selectively reduces the probability of survival of children of all ages) has been widely practiced throughout history in many societies. For example, in much of Western Europe throughout the 15th to the 19th centuries it was customary to send newborn infants to live with rural wet nurses often for 9 months to a year or more. Some of these wet nurses were reported to nurse two or three infants at once (Sussman, 1975). Mortality rates for these infants were appallingly high. In Britain in the 1870s, the overall infant mortality rate was approximately 15%, but the mortality rates of infants living with "baby farmers" reached 90% (Sauer, 1978).

While deliberate progenicide may not be a statistically common event, it has been observed for all the major groups of higher primates, including humans (Daly & Wilson, 1983; Dickemann, 1979; Hrdy, 1979). For humans, especially, it has commonly been associated with control of the sex ratio. Drawing on the concepts and principles of evolutionary biology, Dickemann (1979) describes an abundance of historical data to bear on her argument that male preference and the pattern of hypergamy, where females prefer and tend to mate with males of higher status than they, are ultimately linked to greater variance in male than in female reproductive success. Using ideas from Trivers and Willard (1973) she argues that skewed sex ratios represent the outcome of reproductive strategies that increase the inclusive fitness of the individual parent. For example, differential investment in a high quality male gains a mother whose SES is high more grandchildren because he will be able to compete successfully with other males for access to females. Conversely, investment in daughters is a useful strategy for lower SES mothers because, while their sons will not fare as well in competition with other males, their daughters may be attractive to higher status males. Because sex-differential mortality ensures an excess of females at all social levels, it would be predicted that high status families would be more likely to commit infanticide toward their daughters and find brides for their sons among lower status families who will pay a dowry for their daughter's alliance with a high status male. The data fit this model rather well (e.g. Miller, 1981).

The phenomenon of progenicide makes clear that: (1) actions harmful to children are found throughout the historical and cultural record; (2) such practices do not necessarily imply individual or cultural pathology; (3) these practices may be adaptive from an evolutionary perspective, i.e., they may contribute to the parents' inclusive fitness under the ecological conditions in which they find themselves. It should not be assumed, however, that we make conscious calculated assessments of actions that may affect our reproductive success. This is probably seldom, if ever, the case. Instead, there are, undoubtedly, a multitude of proximate mechanisms that bridge the gap between changing ecological conditions and patterns of childrearing. Social norms, values, and beliefs may well rank among these mechanisms. An example would be cultural norms prescribing that male infants should be breastfed longer than female infants. Beliefs may develop around such rules. For instance, in rural Taiwan, mothers presumably believe that earlier weaning assures their daughters of an earlier menopause, and a welcome end to the round of childbearing (Wolf, 1972). In the Ecuadorian Highlands, there is a widespread belief that if a girl is nursed past one year she will at sexual maturity become boy-crazy and rebellious (McKee, 1977). These can be seen as examples where biological and cultural evolution are complementary. As Durham (1976) has argued, both biological and cultural attributes of human beings result to a large degree from the selective retention of traits that enhance the inclusive fitness of individuals in their environments despite differences between the mechanisms of selection and regardless of their relative importance in the evolution of a trait.

To return to our central point, the role of such cultural norms and beliefs may be especially important in explaining normative child maltreatment. They may be of less importance, however, when looking at harm to children that is culturally proscribed. It is not yet known whether there are significant differences between child maltreatment that is prescribed normatively and that which is proscribed. It is even possible that one precludes the other. In other words, the kinds of actions that we consider abusive in our society may exist, in part, because infanticide and, to some extent, abortion are prohibited.

Ecological Instability and Child Maltreatment

Clearly, then, cultural norms can increase the probability of child maltreatment, but so might instability in the environment in which parents must live. The concept of *ecological instability* (Burgess, 1986) refers to circumstances where the balance of resources to stress is

weighted in favor of stress. Given the length of time and amount of effort that goes into child care, human parents, especially, should be sensitive to turbulence in the environment that signals either improvements in or degradation of available resources.

Because no organism inhabits a completely predictable environment, natural selection has produced capabilities for facultative adjustment of behavior in organisms allowing them to alter their responses to changing environments adaptively. In *K*-strategists, in which the individual requires a long time to reach reproductive maturity and in which small numbers of young are produced, the importance to the individual of being able to "track" or adjust to changes in environmental quality is critical. This is especially true in humans, for example, where mistaken judgments by parents can lead to death of one or all offspring. Unstable diversity in environments is precisely where facultative behaviors would enjoy the greatest advantage over obligate, environmentally insensitive ("instinctive"), behavioral strategies (Alcock, 1984). Because those traits with the larger effects on inclusive fitness are expected to be under the most intense selection pressures, humans ought to be sensitive to cues indicating changes in the availability of critical resources. Therefore, among the key behavioral systems affected by such changing perceptions would be mating and parenting, because they are so closely related to inclusive fitness.

We see these very general issues as directly related to the literature on family violence because an underlying theme in the findings on child abuse is the adverse influence of environmental uncertainty and stress. This is the case, we suggest, because circumstances indicative of ecological instability are often marked by a shift in the balance of resources to stress favoring stress. We can see the critical role of ecological instability even in nonhuman groups. For example, an increased probability of infanticide in nonhuman primates has been associated with factors as diverse as increasing population density, change in dominance hierarchy, decreased parental control of vital natural resources, uncertain parenthood, and disturbance of the ecology of groups by humans (Hrdy, 1979).

Using the concept of ecological instability, a family can be conceptualized as an ecosystem, i.e., a community interacting with its habitat. Under normal conditions, we may assume that an ecosystem will be in a state of dynamic equilibrium such that there is a fairly equal balance, or even an excess, of resources to stress. To extent that the resources a family can marshal decrease (or are perceived to decrease) in proportion to the stress with which it must cope, conflict and violence become more likely (Burgess & Youngblade, 1987).

One major outcome of research on child abuse in the United States during the 1970s and 1980s was an increasing awareness of multiple

correlates of abuse operating at many different levels of analysis. Many of the common correlates, or "marker variables" associated with child maltreatment can be conceptualized as indicators of ecological instability. For example, it has been reported that parents isolated from important social support systems in their neighborhoods are more likely to be violent toward their children (Garbarino & Crouter, 1978). Low income and joblessness have also been associated with higher levels of child maltreatment (e.g., Straus, 1980). Other research has documented the importance of the social structure of the family itself. Large families, for example, are disproportionately found in abuse statistics. Similarly, rates of abuse are higher in single-parent households (Freedman, 1976) and in households with step relations (Burgess, Anderson, Schellenbach, & Conger, 1981; Daly & Wilson, 1980). Because male parental investment is expected to vary facultatively and adaptively with respect to paternity certainty, it is stepfather-stepchild relationships that are most at risk for abuse. And, indeed, in two-parent households, when there are both biological and step-offspring present, stepchildren are the more likely targets of abuse (Lightcap, Kurland, & Burgess, 1982).

We are arguing that many of these macro, social-structural, correlates of child abuse should be regarded as markers of ecological instability, i.e., they represent situations where the level of stress often exceeds the family's resources. Examples would include many of the circumstances surrounding low socioeconomic status including below-average family income and chronic joblessness and all the problems these conditions produce such as suboptimal housing in neighborhoods marked by high crime rates and high migration, less than adequate diets, and frequent disputes with creditors. Similarly, at the level of the community, parents who do not have ready access to the resources associated with effective support systems are going to find themselves experiencing considerable stress. Research has also documented that certain features of family structure and organization are associated with chronic or periodic stress such as large family size, single parenthood, and step relations in a family (see e.g., Belsky, 1980; Burgess, et al., 1981; Straus, Gelles, & Steinmetz, 1981). All of these factors, as we have just discussed, have been found to be predictive of higher rates of child maltreatment (Burgess, 1979).

Wahler (1980) has shown how the conditions outlined above increase the likelihood that a person will frequently have aversive exchanges with others outside as well as within the family. Indeed, Wahler and Hahn (in press) have shown that, rather than interacting with people who form a warm, supportive network and who provide assistance, empathy, and problem-solving help, these parents more often interact with others who are experiencing levels of stress similar to themselves. The outcome is that instead of helping each other, they often simply match "war stories," thus exacerbating rather than ameliorating the

aversive nature of the interactions they have outside the family. To the extent that these interactions are aversive for the abusive parent, the parents will tend to avoid them, perhaps interacting only under duress. In this way, the abusive parent becomes more and more isolated from useful social supports and violence becomes even more likely.

Coercive Interpersonal Contingencies and Child Maltreatment

Of course, these indicators of ecological instability do not always lead to abuse. It is essential to consider factors which can allow us to account for individual differences in response to accumulating stress. The first factors to be considered are the individual traits of both the abuser and the abused child. Parental characteristics which have been associated with child abuse include, for example, depression and anxiety (Wolfe, 1984) and autonomic hyperreactivity (Vasta, 1982). Characteristics which have been linked to the abused children, themselves, include difficult temperaments (Frodi, 1981; Johnson & Morse, 1968), mental retardation (Sandgrund, Gaines, & Green, 1974), and hyperactive or otherwise "difficult-to-handle" behavior (Reid, Patterson, & Loeber, 1982).

As important as these individual traits may be, we still need to identify the conditions under which they, in turn, are actually translated into violent behavior. We propose that the causal pathway here is to be found in the patterns of communication or interaction that develop between parents and children. What we are suggesting is that certain styles of interaction between abusing parents and their children may be the circumstances that allow us to specify when conditions of ecological instability are most likely to result in child maltreatment.

When we look at research that has examined interaction or communication patterns in abusive families, we are immediately alerted to the importance of interpersonal contingencies of reinforcement and punishment. In these studies, investigators have found that abusive parents are often very poor observers of their children's behavior (Burgess et al., 1981). This lack of effective and accurate monitoring may be due to the parent's lack of skills (Patterson, 1980, 1985), to a lack of resources (Wolfe, 1984), or both. In either case, one outcome of poor observing skills is that such parents tend to respond to their children in ways that are functionally noncontingent (Dumas & Wahler, 1985; Patterson, 1979; Wahler & Dumas, 1986). Apart from making life rather unpredictable for children, this circumstance has serious consequences for the parent-child relationship. Rewards that are consistently provided on a noncontingent basis may eventually lose whatever ability they had to function as positive reinforcers (Bijou & Baer, 1961). Imagine, for

example, a family where the parents, perhaps due to their failure to track their child's behavior accurately, are just as likely to give their approval when their child misbehaves as when the child behaves properly. Later on, any attempts to use their approval in a deliberate effort to regulate the child's behavior will likely fail. Under these circumstances, their approval is not functioning as a positive reinforcer for their child. Because of this, parents who respond noncontingently to their children are, thereby, depriving themselves of one major source of influence over their children, i.e., the use of positive incentives (Burgess & Richardson, 1984). Their efforts to use positive responses to control their child's behavior may have been weakened due to lack of success. This history of ineffective child management may also account for the finding that abusive parents view children and child-related activities less positively than do nonabusive parents (Disbrow, Doerr, & Caulfield, 1977). These parental cognitions are not without meaning. Patterson (1984), for example, found a close relationship between a mother's labeling of her child as deviant and her rejection of the child. Such rejection makes the child a more likely target for abuse (Burgess & Garbarino, 1983).

Given the normal conflicts of interest that characterize family life, coupled with a low rate of positive reinforcement, parents inevitably must turn to other measures. This may explain the higher frequency of aversive (punitive) behavior directed by abusive parents to their children. Reid (1984) reports, for example, that abusive mothers display approximately twice the rate of aversive behavior of nonabusive parents with child management problems and nearly four times the rate found in nondistressed families. Other investigators have found a similar pattern (e.g., Bousha & Twentyman, 1984).

Interestingly, there is evidence that an abusive parent's use of punishment is often a function of events other than the child's behavior. For instance, Dumas and Wahler (1984) have shown that higher rates of aversive behavior are especially common when the parent has had a "bad day." On those days when an abusive parent has negative interactions with social agencies, neighbors, husbands, or boyfriends, and is especially irritable, she is most likely to exhibit high rates of aversive behavior, perhaps even abusive behavior, toward her child, regardless of what the child is doing. It is important to note that punishment which is provided noncontingently becomes increasingly ineffective, at least at levels acceptable to society (Parke, Deur, & Saivin, 1970). Thus, at those times when the parent is very irritable, matters can quickly get out of hand. This would be particularly likely if the child reciprocated the parent's abusive behavior, or if there is a flare-up in fighting among siblings. Both possibilities are more common in abusive families (Burgess & Conger, 1978; Burgess et al., 1981; Reid et al., 1981).

As exchanges within the family become increasingly negative, emotions flare (Vasta, 1982) and it becomes more and more difficult to ter-

minate the aversive interchanges. The evidence shows that abusive mothers are much less successful in their child-management efforts than nonabusive mothers. In one study, it was reported that nondistressed mothers were successful in 86% of their discipline attempts; nonabusive mothers with child-management problems were successful 65% of the time; abusive mothers, on the other hand, were effective in only 46% on their discipline attempts (Reid et al., 1981). These abusive parents were also less likely to use positive acts such as teasing or humor and more likely to use physical coercion in their attempts at discipline.

Over time, then, interactions within the family become less and less positive, and more negative. Indeed, there is growing evidence of a significant relationship between the frequency of mildly aversive interchanges and the rate of intensely aversive interchanges between parents and children (e.g., Reid, 1984). The more often a parent exhibits mild forms of aversive behavior, the more likely it is that significantly abusive behavior will occur. Consequently, violent attacks may not only result from strong situational or personal stress, but also from the outcome of progressively aversive exchanges between a child and a parent who is frequently and easily irritated and unskilled in quickly resolving conflicts of interest and discipline confrontations. It is possible, of course, that the probability of an abusive assault is greatest on those days where levels of stress are high and the parent's effectiveness at child management is especially low.

In any case, this tendency to be negative and hostile will, of course, contribute to the reduction of exchanges marked by positive emotions. Because these exchanges become unpleasant, the impetus for family interaction becomes extinguished, except during occasions when contact is necessary. The overall effect, then, will be lowered frequencies of family interaction (Burgess & Conger, 1978).

Conclusions

A major goal of this chapter has been to explore the application of evolutionary theory to the explanation of child maltreatment in families. Key concepts such as inclusive fitness, parental investment, certainty of paternity and differentially optimal reproductive strategies for males and females all lead to the expectation of recurring conflicts of interest in families that may, under identifiable circumstances, lead to violence in families, including significant maltreatment of children.

Drawing on these evolutionary concepts, as well as cross-cultural studies, we suggest that the maltreatment of children, in some circumstances, may have contributed, paradoxically, to the inclusive fitness of the abusing parents. Examples discussed include infanticide and dietary practices that favor male children over female children. Such

practices may function to create adaptive sex ratios. This might especially be the case in circumstances of ecological instability such as droughts, famine, natural catastrophes, epidemics, and warfare where the naturally higher mortality rates of male infants may lead to skewed sex ratios. We should remember, however, that cultural practices like these do not require conscious attention to matters of inclusive fitness. This is unnecessary because cultural norms may serve as proximate mechanisms leading to biologically adaptive behavior. As we have seen, belief systems often grow around cultural norms to guarantee compliance.

Even today, in our society, differential rates of child abuse suggest the past adaptiveness of child maltreatment. Examples include the disproportionately higher rates of maltreatment found for step-children, especially in the stepfather–stepchild relationship, where paternity certainty is zero (Lightcap et al., 1982). We may, in short, be biologically “prepared” to act in hostile ways under certain circumstances to children who share none of our genes. This might especially be the case when resource competition develops between half-brothers and sisters. Similarly, the higher rates of maltreatment found in large, low SES families as well as in single-parent families would be predicted by evolutionary theory. In those situations, competition for resources is exacerbated and the costs associated with parental investment may be higher than normal. Finally, the higher rates of abuse found among children who were born prematurely, who are difficult to manage, or who are physically, intellectually, or emotionally handicapped are, likewise, consistent with the principles of evolutionary theory in that such youngsters are poor prospects for investment that will lead to their successful reproduction as adults (see Lightcap et al., 1982).

We need to emphasize, however, that we are not arguing that child maltreatment is necessarily adaptive biologically in all or even in most cases. In fact, it is quite possible that some of our behavior today is biologically maladaptive. An example of this might be the lowered fertility associated with the demographic transition. Demographers use that term to refer to the fact that modern industrial societies seem to have gone through three distinct stages. The first is marked by high mortality and high fertility. The second stage, associated with technological improvements in food production and sanitation, is identified by low mortality and high fertility. The third stage evidences both low mortality and low fertility. A perplexing problem for evolutionary theory is how to explain the especially low fertility of middle and upper middle SES couples.

We will not be able in this chapter to examine this matter in detail, but, we can at least suggest the possibility that many of the historically proximate means to reproductive success have become ends in themselves. For example, given the discovery of easy and effective contra-

ceptive techniques, we can now control our fertility more directly, yet still derive the benefits of our propensity to enjoy sex. This decoupling of proximate means and ultimate reproductive ends could easily lead to the trends we see in modern industrial societies such as delayed age at marriage, cohabitation, postponed child birth, and higher rates of childlessness (Davis, 1985). It may also lead to increased preoccupation with ancillary aspects of reproductive effort such as physical attractiveness, dating and other mating tactics and, perhaps especially, resource accumulation. In short, bearing children may be judged to be less attractive than other valued ends such as avoiding the pain of childbirth, the inconvenience of parenthood, the pursuit of an advanced education, a career, or the maximization of economic comfort (Barkow & Burley, 1980). If there is any merit to this argument, it should also apply to the parental effort one directs to those children one has. In other words, disproportionate attention to immediate proximate mechanisms of reproduction itself at the expense of parental investment may lead to an increased likelihood of child abuse and neglect because the progeny themselves may jeopardize success in the dating or mating "games."

Two points should be emphasized here. First, we cannot assume, *a priori*, that the maltreatment of children is universally adaptive or maladaptive. It clearly can be either, depending on prevailing ecological circumstances. Second, the theory of evolution is as relevant for the explanation of maladaptive parental behavior as it is of adaptive parental effort. Both cases are grounded in the underlying logic of the theory (Symons, 1979, 1986).

Whether specific incidents of child maltreatment contribute to the abusing parent's inclusive fitness or not, we have argued that the probability of maltreatment increases with increasing ecological instability. Many of the common correlates of child abuse clearly involve circumstances where a parent's resources are stretched to the limit and where stress becomes increasingly difficult to manage. Examples discussed include poverty, joblessness, living in high crime neighborhoods, and the absence of social support systems. We also suggested that some of the other correlates of maltreatment such as problem drinking, parental depression, and anxiety may, themselves, be the product of ecological instability. An important part of our thesis is the idea that it is biologically adaptive to be sensitive to changes in the ecology that signal improvement in or degradation of available environmental resources. Because mating and parenting behavior are so closely tied to inclusive fitness, they should be especially sensitive to circumstances indicative of ecological instability.

An important corollary of evolutionary ecology is recognition that behavior is not necessarily functionally invariant: *i.e.*, a particular behavior may contribute to inclusive fitness in one environment but not in another. Critics of the application of evolutionary theory to

human behavior sometimes claim that evolutionists ignore individual differences. We have tried to address the issue of individual differences by identifying proximate processes that seem to govern whether conditions of ecological instability are actually translated into child maltreatment.

The proximate processes that we have discussed are interpersonal contingencies of reinforcement and punishment. We have suggested that coercive interpersonal contingencies are proximate mechanisms connecting social indicators of ecological instability to actual occurrences of child maltreatment. This connection is not simple, however. First, because these interpersonal contingencies have developed within the family, it follows that child maltreatment may occur even in the absence of most or all of the marker variables so long as the interpersonal contingencies operating in the family have become progressively coercive (Burgess & Richardson, 1984). On the other hand, there is also the possibility that the common indicators of ecological instability denote circumstances that place parents at risk for maltreatment because they increase the likelihood of conditions that can lead to coercive interpersonal contingencies. Our guess is that both possibilities occur. In any case, the effects of ecological instability on families are transmitted via these patterns of family interaction (Burgess, 1986).

The theoretical perspective we have taken represents an attempt to apply evolutionary concepts to a problem, child maltreatment, that intuitively appears inconsistent with notions of inclusive fitness. This perspective also attempts to identify intermediate-level circumstances that link ultimate issues of inclusive fitness to proximate causes of child maltreatment. We have conceptualized these circumstances as manifestations of ecological instability where the stress a parent experiences exceeds available resources.

Our evolutionary-ecological perspective addresses the issue of individual differences by attempting to specify mechanisms whereby macro-indicators of ecological disturbance such as socioeconomic status can lead to micro-level processes that culminate in violence and other forms of maltreatment. Coercive patterns of family interaction represent the principal causal pathway that connects ecological instability to child maltreatment. This raises the possibility that some of the common correlates of child abuse are, themselves, reactions to sudden or chronic ecological instability. For example, alcoholism or problem-drinking, depression, and anxiety may be responses to ecological stress to the family, such as loss of employment, excessive financial debt, or divorce. Consequently, violence to children may be a direct result of ecological instability or it may be mediated through certain personal characteristics of the parents such as emotional disturbances (Elmer, 1967), difficulty in dealing with aggressive impulses (Wasserman, 1967), alcoholism (Blumberg, 1974), or autonomic hyper-

reactivity (Vasta, 1982). Thus, there is the intriguing possibility that these individual traits, which have previously been assumed to precipitate abusive behavior, may actually be the result of the same factors that lead to family violence itself: ecological instability and the uncertainty of successful reproductive effort.

REFERENCES

- Alcock, J. (1984). *Animal behavior: An evolutionary approach*. Sunderland, MA: Sinauer Associates.
- Alexander, R.D. (1979a). *Darwinism and human affairs*. Seattle, WA: University of Washington Press.
- Alexander, R.D. (1979b). Natural selection and social exchange. In R. L. Burgess & T.L. Huston (Eds.), *Social exchange in developing relationships*. New York: Academic Press.
- Aries, P. (1970). *Centuries of childhood, a social history of family life*. New York: Knopf.
- Barkow, J.H. & Burley, N. (1980). Human fertility, evolutionary biology, and the demographic transition. *Ethology and Sociobiology*, 1, 163–180.
- Bateson, P.G. (1982). Preferences for cousins in Japanese quail. *Nature*, 295, 236–237.
- Belsky, J. (1980). Child maltreatment: An ecological integration. *American Psychologist*, 35, 320–335.
- Bijou, S.W. & Baer, D.M. (1961). *Child development, Vol. 1: A systematic and empirical theory*. New York: Appleton-Century-Crofts.
- Blumberg, M.L. (1974). Psychopathology of the abusing parent. *American Journal of Psychotherapy*, 28, 21–29.
- Bousha, D.M., & Twentyman, C.T. (1984). Mother-child interactional style in abuse, neglect, and control groups: Naturalistic observations in the home. *Journal of Abnormal Psychology*, 93, 106–114.
- Bowlby, J. (1951). Maternal care and mental health. *World Health Organization Bulletin*, 3, 355–534.
- Burgess, R.L. (1979). Child abuse: A social interactional analysis. In B.B. Lahey & A.E. Kazdin (Eds.), *Advances in clinical child psychology*. New York: Plenum.
- Burgess, R.L. (1986). Social incompetence as a precipitant to and consequence of child maltreatment. *Victimology: An International Journal*, 10, 72–86.
- Burgess, R.L., Anderson, E.A., Schellenbach, C.J., & Conger, R. (1981). A social interactional approach to the study of abusive families. In J.P. Vincent (Ed.), *Advances in family intervention, assessment, and theory: An annual compilation of research* (Vol. 2, pp. 1–46). New York: JAI Press.
- Burgess, R.L. & Conger, R.D. (1978). Family interaction in abusive, neglectful, and normal families. *Child Development*, 49, 1163–1173.
- Burgess, R.L., & Draper, P. (In press). The explanation of family violence: The role of biological, behavioral, and cultural selection. In L. Ohlin & M. Tonry (Eds.), *Crime and justice: An annual review of research*, Volume 11. Chicago: The University of Chicago Press.

- Burgess, R.L. & Garbarino, J. (1983). Doing what comes naturally? An evolutionary perspective on child abuse. In D. Finkelhor, R. Gelles, G. Hotaling, & M. Straus (Eds.), *The dark side of families: Current family violence research* (Ch. 5, pp. 88–101). Beverly Hills, CA: Sage Publications, Inc.
- Burgess, R.L. & Richardson, R.A. (1984). Coercive interpersonal contingencies of reinforcement as a determinant of child abuse: Implications for treatment and prevention. In R.F. Dangel & R.A. Polster (Eds.), *Behavioral parent training: Issues in research and practice* (pp. 239–259). New York: Guilford Publications.
- Burgess, R.L. & Youngblade, L.M. (1987). Social incompetence and the intergenerational transmission of abusive parental practices. In R. Gelles, G. Hotaling, D. Finkelhor, & M. Straus (Eds.), *New directions in family violence research*. Beverly Hills, CA: Sage Publications, Inc.
- Cassidy, C.M. (1980). *Benign neglect and toddler malnutrition: Social and biological predictors of nutritional status, physical growth, and neurological development*. New York: Academic Press.
- Cheney, D., Seyfarth, R., & Smuts, B. (1986). Social relationships and social cognition of nonhuman primates. *Science*, 234, 1361–1366.
- Cuthbertson, D.P. (1967). Feeding patterns and nutrient utilization: Chairman's remarks. *Proceedings of the Nutrition Society*, 26, 143–144.
- Daly, M. & Wilson, M.I. (1980). Abuse and neglect of children in evolutionary perspective. In R.D. Alexander & D.W. Tinkle (Eds.), *Natural selection and social behavior*. New York: Chiron Press.
- Daly, M., & Wilson, M.I. (1983). *Sex, education, and behavior*. North Scituate, MA: Duxbury Press.
- Davis, K. (1985). *Contemporary marriage: Comparative perspectives on a changing institution*. New York: Russell Sage Foundation.
- Dawkins, R. (1982). *The extended phenotype: The gene as the unit of selection*. Oxford: Oxford University Press.
- DeMause, L. (1974). The evolution of childhood. In L. DeMause (Ed.), *The history of childhood*. New York: Psychohistory Press.
- DeVore, I. (1963). Mother-infant relations in free-ranging baboons. In H.L. Rheingold (Ed.), *Maternal behavior in mammals*. New York: Wiley.
- Dickeman, M. (1979). Female infanticide, reproductive strategies, and social stratification: A preliminary model. In N. Chagnon & W. Irons (Eds.), *Evolutionary biology and human social behavior*. North Scituate, MA: Duxbury Press.
- Disbrow, M.A., Doerr, H.O., & Caulfield, C. (1977). *Measures to predict child abuse*. Project Report, Seattle: University of Washington.
- Draper, P. & Harpending, H. (1982). Father absence and reproductive strategy: An evolutionary perspective. *Journal of Anthropological Research*, 38(3), 255–273.
- Dumas, J.E. & Wahler, R.G. (1985). Indiscriminate mothering as a contextual factor in aggressive-oppositional child behavior: "Damned if you do and damned if you don't." *Journal of Abnormal Child Psychology*.
- Durham, W.H. (1976). The adaptive significance of cultural behavior. *Human Ecology*, 4(2), 89–121.
- Elmer, E. (1967). *Children in jeopardy: A study of abused minors and their families*. Pittsburgh: University of Pittsburgh Press.

- Fisher, R.A. (1958). *The genetical theory of natural selection*. New York: Dover.
- Freedman, R. (1976). Child abuse: A review of the psychosocial research. In Herner Co. (Eds.), *Four perspectives on the status of child abuse and neglect research*. Washington, DC: National Center on Child Abuse and Neglect.
- Frodi, A.M. (1981). Contributions of infant characteristics to child abuse. *American Journal of Mental Deficiency*, 85, 341–349.
- Garbarino, J. & Crouter, A. (1978). Defining the community context of parent-child relations: The correlates of child maltreatment. *Child Development*, 49, 604–616.
- Garcia, J. & Koelling, R.A. (1976). Relation of cure to consequence in avoidance learning. *Psychonomic Science*, 4, 123–124.
- Gelles, R.J. & Straus, M.A. (1979). Determinants of violence in the family: Toward a theoretical integration. In W.R. Burr, R. Hill, I.K. Nye, & I.L. Reiss (Eds.), *Contemporary theories about the family* (pp. 549–581). New York: The Free Press.
- Hrdy, S.B. (1979). Infanticide among animals: A review, classification, and examination of the implications for the reproductive strategies of females. *Ethology and Sociobiology*, 1, 13–40.
- Hrdy, S.B. (1981). *The woman that never evolved*. Cambridge, MA: Harvard University Press.
- Johnson, B. & Morse, H.A. (1968). Injured children and their parents. *Children*, 15, 147–152.
- Kleiman, D.G. (1977). Monogamy in mammals. *Quarterly Review of Biology*, 52, 39–69.
- Kleiman, D.G. & Malcolm, J.R. (1981). Evolution of male parental investment in mammals. In D.J. Gubernick & P.H. Klopfer (Eds.), *Parental care in mammals* (pp. 347–387). New York: Plenum Press.
- Krebs, J.R. & Davies, N.B. (1987). *An introduction to behavioral ecology*. Sunderland, MA: Sinauer.
- Kurland, J.A. & Gaulin, S.J.C. (1984). The evolution of male parental investment: Effects of genetic relatedness and feeding ecology on the allocation of reproductive effort. In D.M. Taub (Ed.), *Primate paternalism* (pp. 259–308), Van Nostrand Reinhold.
- Langer, W.L. (1972). Checks on population growth: 1750–1850. *Scientific American*, 226(2), 92–99.
- Lasch, C. (1977). *Haven in a heartless world*. New York: Basic Books, Inc.
- LeBouef, B.J. (1974). Male-male competition and reproductive success in elephant seals. *American Zoologist*, 14, 163–176.
- Lessing, D. (1973). *The Golden Notebook*. New York: Bantam.
- Levine, R.A. & Levine, B.B. (1963). Nyansongo: A Gusii community in Kenya. In B.B. Whiting (Ed.), *Six cultures, studies of child rearing* (pp. 19–202). New York: Wiley.
- Lightcap, J.L., Kurland, J.A., & Burgess, R.L. (1982). Child abuse: A test of some predictions from evolutionary theory. *Ethology and Sociobiology*, 3, 61–67.
- Linton, R. (1936). *The study of man*. New York: Appleton Century Company.
- McKee, L. (1977, November-December). *Differential weaning and the ideology of gender: Implications for Andean sex ratios*. Paper read at the 76th annual meeting of the American Anthropological Association, Houston, TX.

- Miller, B. (1981). *The endangered sex: Neglect of female children in rural North India*. Ithaca, NY: Cornell University Press.
- Newman, M.T. (1961). Biological adaptation of man to his environment: heat, cold, altitude, and nutrition. *Annals of the New York Academy of Sciences*, 91, 617-933.
- Parke, R.D., Deur, J.L., & Saivin, M. (1970). The intermittent punishment effect in humans: Conditioning or adaptation. *Psychonomic Science*, 18, 193-194.
- Patterson, G.R. (1979). A performance theory for coercive family interaction. In R.B. Cairns (Ed.), *The analysis of social interactions: Methods, issues, and illustrations*. Hillsdale, NJ: Lawrence Erlbaum.
- Patterson, G.R. (1980). Mothers: The unacknowledged victims. *Monograph of the Society for Research in Child Development*, No. 186.
- Patterson, G.R. (1982). The unattached mother: A process analysis. In W. Hartup & Z. Rubin (Eds.), *Social relationships: Their role in children's development*. Harwichport Conference: Harwichport, MA.
- Patterson, G.R. (1985). Beyond technology: The next stage in the development of parent training. In L. Abate (Ed.), *Handbook of family psychology and psychotherapy*. New York: Dow-Jones-Irwin.
- Pianka, E.R. (1970). On *r*- and *k*-selection. *American Naturalist*, 104, 592-597.
- Pollitt, E. (1973). Behavior of infant in causation of nutritional marasmus. *American Journal of Clinical Nutrition*, 26, 264-270.
- Reid, J.B. (1984, In press). Social-interactional patterns in families of abused and non-abused families. In C. Zahn-Waxler, M. Cummings, & M. Radke-Yarrow (Eds.), *Social and biological origins of altruism and aggression*. Cambridge Press.
- Reid, J.B., Patterson, G.R., & Loeber, R. (1982). The abused child: victim, instigator, or innocent bystander? In D.J. Bernstein (Ed.), *Response structure and organization*. Lincoln, NE: University of Nebraska Press.
- Reid, J.B., Taplin, P.S., & Loeber, R. (1981). A social-interactional approach to the treatment of abusive families. In R. Stuart (Ed.), *Violent behavior: Social learning approaches to prediction, management, and treatment*. New York: Brunner/Mazel.
- Rohner, R.P. (1975). *They love me, they love me not*. New Haven: Human Relations Area Files Press.
- Sandgrund, A.K., Gaines, R., & Green, A. (1974). Child abuse and mental retardation: A problem of cause and effect. *American Journal of Mental Deficiency*, 79, 327-330.
- Sanjur, D.M., Cranoito, J., Rosales, L., & vonVeen, A. (1970). Infant feeding and weaning practices in a rural preindustrial setting: A sociocultural approach. *Acta Paediatrica Scandinavia*, Suppl. 200.
- Sauer, R. (1978). Infanticide and abortion in nineteenth century Britain. *Population Studies*, 32(1), 81-93.
- Scrimshaw, N.S. (1984). Infanticide in human populations: Societal and individual concerns. In G. Huasfater & S. Hrdy (Eds.), *Infanticide: Comparative and evolutionary perspective*. New York: Aldine.
- Scrimshaw, N.S., Taylor, C.E., & Gordon, J.E. (1968). Interactions of nutrition and infection. *World Health Organization Monograph Series*, 57.
- Straus, M.A., Gelles, R.J., & Steinmetz, S.K. (1981). *Behind closed doors: Violence in the American family*. Garden City, NY: Doubleday.

- Sussman, G. (1975). The wet-nursing business in nineteenth century France. *French Historical Studies*, *IX*(2), 304–328.
- Symons, D. (1979). *The evolution of human sexuality*. New York: Oxford University Press.
- Symons, D. (1986). Sociobiology and Darwinism: Commentary. *Behavior and Brain Sciences*, *9*, 208–209.
- Trivers, R.L. (1972). Parental investment and sexual selection. In B. Campbell (Ed.), *Sexual selection and the descent of man* (pp. 1871–1971). Chicago: Aldine.
- Trivers, R.L. (1974). Parent-offspring conflict. *American Zoologist*, *14*, 244–264.
- Trivers, R.L. (1985). *Social evolution*. Menlo Park, CA: Benjamin/Cummings.
- Trivers, R.L. & Willard, D. (1973). Natural selection of parental ability to vary the sex ratio of offspring. *Science*, *179*, 90–92.
- van den Bergh, P. (1979). *Human family systems: An evolutionary perspective*. New York: Elsevier.
- Vasta, R. (1982). Physical child abuse: A dual-component analysis. *Developmental Review*, *2*, 125–149.
- Vehrencamp, S.L. & Bradbury (1984). Mating systems and ecology. In J.R. Krebs & N.B. Davies (Eds.), *Behavioral ecology: An evolutionary approach*, 2nd edition. Oxford: Blackwell Scientific Publications.
- Wahler, R.G. (1980). The insular mother: Her problems in parent-child treatment. *Journal of Applied Behavior Analysis*, *13*, 207–219.
- Wahler, R.G., & Hahn, D.M. (in press). The communication patterns of troubled mothers: In search of a keystone in the generalization of parenting skills. *Education and Treatment of Children*.
- Wahler, R.G. & Dumas, J.E. (1986). Maintenance factors in coercive mother-child interactions: The compliance and predictability hypotheses. *Journal of Applied Behavior Analyses*, *19*, 13–22.
- Wallace, B. (1958). The comparison of observed and calculated zygotic distributions. *Evolution*, *12*, 113–115.
- Washburn, S. (1978). Human behavior and the behavior of other animals. *American Psychologist*, *33*, 405–418.
- Wasserman, S. (1967). The abused parent of the abused child. *Children*, *14*, 175–179.
- Williams, G.C. (1966). *Adaptation and natural selection*. Princeton: Princeton University Press.
- Wittenberger, J.F. (1980). *Animal social behavior*. Boston: Duxbury Press.
- Wolf, M. (1972). *Women and the family in rural Taiwan*. Stanford: Stanford University Press.
- Wolfe, D.A. (1984). *Behavioral distinctions between abusive and nonabusive parents: A review and critique*. Paper presented at the Second Family Violence Research Conference, University of New Hampshire.
- Wolff, R.J. (1965). Meanings of food. *Tropical and Geographical Medicine*, *17*, 45–51.
- Zeveloff, S.I. & Boyce, M.S. (1980). Parental investment and mating systems in mammals. *Evolution*, *34*(5), 973–982.

11

Socialization in the Context of the Family: A Sociobiological Perspective

KEVIN B. MACDONALD

Because of its status as the primeval form of human social organization, the human family must play a central role in evolutionary theorizing about development. The purpose of this chapter is to provide a sociobiological framework within which substantial areas of the literature on the family deriving from developmental psychology can be integrated.

From an evolutionary perspective the family must be viewed as in a delicate balance between centripetal forces which tend to make the family unit a cohesive social structure and centrifugal forces which tend to pull it apart. If indeed natural selection has occurred at the individual level, the existence of advanced social structures such as the family presents a major theoretical problem. On the one hand, the centrality of self-interest in sociobiological theorizing leads to viewing the family as a battleground where conflict of interest predominates, while on the other hand it is expected that the family will develop mechanisms of social cohesion which will function to raise well-adapted offspring. As indicated in Chapter 1, Trivers was the first to notice this. In his discussion of parent-offspring conflict he emphasizes that individuals within a family have the same interest only up to a point. It is in the interest of both the offspring and the parents, perhaps including the father, for the parents to invest in the offspring. But this symmetry of interest disappears when further investment in an individual offspring is disadvantageous to the parents.

The organization of this chapter reflects the tension between centripetal and centrifugal tendencies within the human family. Regarding the centripetal tendencies, the focus is on the proximal affective mechanisms which hold families together and the historical and cross-cultural context of their expression, especially with regard to how they influence development. Centrifugal tendencies within the family occur for a variety of reasons, and in the present case the effects of variation in parental investment resulting from male-female differences in reproductive strategy are emphasized.

The point of view adopted here is explicitly nonreductionist. In previous papers (MacDonald, 1983, 1986d, 1987a; see also this vol., Chap. 1) I have argued for the existence of several independent, nonreducible factors as being relevant to understanding fitness in human societies, and in this chapter the role of economic production and social controls are discussed. The perspective adopted here considers the family to be embedded in a broad cultural and biological matrix (Bronfenbrenner, 1986; Lerner & Kauffman, 1986), ranging from biologically influenced proximal mechanisms, such as the affective systems underlying family functioning and social learning, to social controls on behavior originating both within and beyond the family. The family is embedded also in a cultural and historical context, and these varying contexts profoundly affect development in ways that can be understood within the framework of sociobiological theory.

Centripetal Tendencies Within Families and the Context of Development

From a sociobiological perspective the idea that the nuclear family is the basic form of human social organization implies a high level of paternal investment in offspring. Proximal mechanisms fostering male-female as well as parent-child social bonding are expected. Several proximal mechanisms which facilitate cohesion of the family grouping have been proposed by sociobiologists, including continuous sexual receptivity of females and concealed ovulation (Alexander, 1979). Both of these mechanisms would provide an incentive for a male to maintain continuous ties with a female in order to ensure his paternity. However, the centripetal mechanism that is most relevant for thinking about child development involves the proximate, epigenetic mechanisms underlying parent-parent and parent-child affective bonds. Knowledge of these mechanisms is essential to understanding the flexibility and control of human behavior, and in the following I will concentrate on developing a biological theory of these affective bonds, describing its adaptive history in human societies and discussing its role in the individual development of children.

AN ETHOLOGICAL THEORY OF AFFECTIVE BONDS

Bowlby's (1969, 1973) ethological theory of attachment has had a wide influence on the research and conceptualization of early parent-child interaction. Bowlby postulates that secure attachment is based on "natural clues" provided by certain stimuli, particularly the presence or absence of the caretaker. These natural clues or epigenetic rules in the

sense of Lumsden and Wilson (1981) form the basis for an ethological theory of familial affective relationships. In particular it is proposed that the epigenetic rules underlying familial interactions program for the subjective, affective valence of social stimulation, so that, for example, the stimulation provided by a sensitive, responsive caretaker is perceived as subjectively pleasurable by a child, while hostile, rejecting environments are perceived as aversive. This type of analysis is formally similar to analyses by Wilson (1975), Pulliam and Dunford (1980), and Barash (1977), who emphasize the evolution of the rewarding properties of certain behaviors as due to selection for reward responses in the limbic system. This type of analysis also provides an evolutionary basis for highly flexible behavioral systems, since it is the affective consequences of environmental stimulation which guide behavior rather than highly stereotyped, internally generated behavioral patterns which were the concern of the classical ethologists. As Sroufe (1979) states, "Affect is the link between the instinctive behavior of animals and the flexible behavior of man" (p. 501).

Another idea that comes out of this theoretical perspective is the general principle that adaptive interactions with the environment are accompanied by subjective, affective pleasure. For example, Barash (1977) asks why sugar tastes sweet. The adaptationist answer is that the food derived from sugar is beneficial so that there has been natural selection for a subjectively pleasurable response to eating sugar. Sexual activity can be analyzed in a similar manner. In the case of familial affective interactions, the collapse of secondary drive theory and the fact that the class of parental behaviors which are subjectively pleasurable to children are nonrandom and cross-culturally universal strongly suggests that the behaviors of parents classed as warm are primary reinforcers to children (see MacDonald, 1984, 1987b for a detailed discussion). Similarly, a wide variety of social games, including physical play between parents and children and the games of early infancy as described by Stern (1977) and Brazelton, Koslowski, and Main (1974), involve the provision of stimuli which are affectively arousing and pleasurable to children. As Berlyne (1960) has pointed out, many aspects of stimulation, such as surprisingness, incongruity, and novelty are intrinsically arousing and pleasurable if they are within an optimal range of intensity.

Human social behavior is thus viewed as driven in large part by evolutionarily derived reward systems specific to particular aspects of social behavior. Such a view is consistent with findings indicating a variety of neuroanatomical sites and neurotransmitter systems which are associated with reward systems in rats (Stein, 1983; see also Panksepp, 1986). Clearly the reward systems underlying human social behavior are likely to be far more complex than those found in the rat. (Rats do not play peek-a-boo with their offspring, nor, I suppose, do they fall in

love.) Such a view is also consistent with theories of personality as involving individual differences in sensitivity in the reward systems of the brain (see, for example, Gray, Owen, Davis, & Tsaltas, 1983; MacDonald, 1987b; Zuckerman, 1983).

The evolutionary logic outlined here is the implicit logic behind the belief by many attachment theorists that secure attachment was adaptive in the "environment of evolutionary adaptedness" (Bowlby, 1969), since sensitive, responsive care giving is associated with secure attachment (Ainsworth, Blehar, Waters, & Wall, 1978). This does not imply that secure attachment or warm parent-child interactions are always adaptive, but does imply that these types of interactions are primitive in humans. As indicated below, there is good reason to believe that under certain conditions, such interactions would be maladaptive.

Familial affective interactions thus emerge as a highly flexible epigenetic system which is able to respond quickly to varying ecological and social conditions. Such systems are environment-expectant in the sense that they bias the individual to respond affectively to certain classes of environmental events. These affective responses in turn have important effects on adaptive behaviors.

FAMILIAL AFFECTIVE RELATIONSHIPS IN CROSS-CULTURAL CONTEXT

Philosophers of science have noted that one aspect of a theory which makes it attractive to scientists is that it is able to incorporate previously unrelated phenomena into a coherent explanatory scheme (e.g., Aronson, 1984). The great bulk of the research focused on cross-cultural variation in development has occurred in the absence of an explanatory theory. For example, several reviews of cross-cultural variation in socialization and family interaction patterns in middle-level horticultural and simple agricultural societies (e.g., Blain & Barkow, this vol., Chap. 13; Draper & Harpending, this vol., Chap. 12; MacDonald, 1984; Weisner, 1984) have noted that these kinship-based societies are characterized by extended families, affectively distant husband-wife and parent-child relationships, polygyny, and lack of father involvement in child rearing. In the absence of a theory as to why these correlations might be expected one is left with little more than the idea that there is a great deal of cultural variation and, if one is an adaptationist, one could propose that these patterns make adaptive sense in the particular econiche these cultures find themselves in. It is the contention of this chapter that sociobiology is the only available theory that can even attempt an explanatory framework for these data and that the sociobiological framework which emerges sheds light on contemporary developmental mechanisms.

The approach developed here utilizes two general types of constructs. The first of these constructs involves the idea of central tendencies in human behavior which are expected on the basis of sociobiological theory, while the second involves contextual variables which affect the expression of these central tendencies. The idea of central tendencies in behavior is a familiar one to developmentalists. McCall (1981) has pointed to the two realms of developmental theory and research, one involving a concern with individual differences and one concerned with developmental functions which can be characterized as a population average of behavior as it develops over time (Wohlwill, 1973). The central tendencies predicted by sociobiological theory constitute average expected levels of certain types of behavior and are consistent with the idea of variation around that average. Sociobiologically predicted central tendencies include the idea that on the whole individuals will be more self-interested than truly altruistic, that males and females will have vastly different reproductive strategies, and that individuals will attempt to advance the interests of genetic relatives (see MacDonald, 1986d, for a discussion).

For the purposes of this chapter sociobiologically expected differences in reproductive strategy are particularly important (see Trivers, 1972, and Wilson, 1975 for a general discussion). Males and females of many different species invest quite different amounts in offspring, with the female typically investing much more in time and energy to reproduction. This leads to the expectation that males will compete for the relatively scarce resource of females with the result that there is a general trend for a higher variance in reproductive success among males than among females. Sexual competition among the males results in some males siring a disproportionate share of the offspring compared to other males. However, natural selection can modify this apparent primitive tendency for a disparity between males and females in the amount of parental investment. For example, many bird species are monogamous, with the male contributing very high investment in the offspring, and in humans the finding that the most primitive forms of human social organization, hunter-gatherer groups, are characterized by monogamy supports the idea that there has been natural selection for greater equality between the sexes for parental investment in humans.

The second ultimate biological source of sex differences is that males have vastly different reproductive capacity than females. A male can sire children by a large number of females, but the reverse is not the case. In human history it has not been uncommon for males to sire large numbers of children by many women, and polygyny is far more common as an accepted practice than exclusive monogamy among preindustrial societies. Moreover, the occurrence of polyandry is vanishingly rare, and apparently confined to cases where the husbands are brothers. It is this biological sex difference which is, in an ultimate sense, responsible for

the differences in reproductive strategy described here; i.e., given this sex difference, it is expected that there will be a central tendency for males to engage in polygyny in the appropriate economic and political circumstances (see below). Described differently, males have more to gain than females by controlling resources because they are able to invest these resources by having several wives and large numbers of children. Viewed in terms of the previous discussion of parental investment, the sex difference in reproductive capacity allows for the possibility of enormous variation between males in their ability to sire offspring depending on their ability to control resources and females. Theoretically this situation sets the stage for relatively intense sexual competition among males compared to females.

Sociobiologically predicted central tendencies in behavior are a fairly weak explanatory device when confronting the variation in behavior seen cross-culturally. In attempting to explain this variation, contextual variables must be introduced. Contextual variables refer to the features of the situation in which the behavior occurs, and for the purposes of this discussion will include the variables of economic production and social controls (see MacDonald, 1983; 1986d, for a detailed discussion). Regarding economic production, anthropologists (e.g., Goody, 1976; Sahlin, 1974) have found it useful to grade human societies in terms of the amount of production per individual. At the low end of this scale are hunter-gatherer societies, followed by relatively primitive (hoe) agriculture and culminating in advanced (plow) agriculture. In terms of evolutionary theory, this increasing production results in an increased potential for sexual competition among males. Due to the asymmetry in reproductive capacity described above, the sexual strategies of males and females are expected to strongly diverge as societies become more productive. Males increasingly compete with each other as more intensive polygyny becomes possible because one individual male is able to control enough resources to support several wives and children. Supporting this general trend, van den Berghe (1979) found an association between increasing economic production and polygyny in a cross-cultural sample. The pinnacle of this trend can be seen in the classical civilizations of Eurasia, where wealthy males were able to control very large numbers of females, and massive differences in Darwinian fitness between males occurred (Dickemann, 1979).

Corresponding to an increasing resource base are more extensive forms of human social organization. At relatively low levels of economic production societies are relatively decentralized and are centered around economically independent nuclear families. As Sahlin (1974) points out, with increasing production families are immersed to a greater extent in extended kinship relations and the conflict between the household and the wider kinship relationships is the central dilemma of these societies. From a sociobiological perspective these

cleavages result from increasing genetic distance as one moves beyond the nuclear family to immersion in extensive kinship relations.

These relationships can be better appreciated by examining the literature on reproductive rituals which are characteristic of many adolescents in preindustrial societies (see MacDonald, 1987a, for a complete discussion). Paige and Paige (1981) note that societies with relatively low levels of production are characterized by extensive reproductive rituals for girls. A man who wants to arrange an attractive marriage for his daughter is unable to rely on an extensive kinship group to enforce his interests but must instead form temporary political alliances to gain support against possible seducers and to assure a proper marriage by advertising the economic success of the girl's family.

In more economically advanced societies, the family is embedded in a large kinship network which can be counted on to safeguard the father's interest in his daughter's marriage, with the result that reproductive rituals are absent. Since sexual competition is increased in these relatively productive societies, the value of the daughter to the father increases, and the practice of bridewealth (which involves economic payments to the family of the bride) becomes common. Indeed, the main function for the protection bestowed by the large kinship group is to make sure that the girl will command the best possible bridewealth and be attractive to the highest-status males (Dickemann, 1981). Economically successful males can ensure high levels of polygyny for themselves and their sons by being able to purchase wives.

Variation in production is also associated with variation in the characteristics of male initiation rites. Societies with extensive kinship relationships are characterized by the presence of large solidary groups of related males which function to control important resources. Despite the genetic ties among the members of the group, the relatively large size of these groups results in large conflicts of interest within the society, and individual males must integrate themselves into this wider community, a need that is not present in the less productive societies characterized by the independent nuclear family. The male reproductive rituals thus appear to be "rites of submission" which function to show allegiance to the tribal elders (Paige & Paige, 1981) in circumstances in which the centrifugal tendencies arising from individual genetic self-interest are particularly likely to occur (MacDonald, 1987a). At lower levels of economic production rituals involving males are relatively uncommon, and if they occur at all they are confined to the immediate family.

The second contextual variable considered here, that of social controls, arises because the behavior of individuals can be controlled by others. Social controls consist of a wide variety of cultural practices which attempt to channel the behavior of individuals and can range from military force to various types of social disapproval. At relatively low levels

of economic production social structure is relatively egalitarian and based on the independent nuclear family. As we have seen, at higher levels of production the extensive kinship group is able to exert greater control over individual behavior, while at the highest levels of production kinship ties weaken as political control by the state becomes increasingly important (Alexander, 1979; Stone, 1977).

Social controls are theoretically important because they can operate independently of the genotypes of the individuals they affect, i.e., they are often insensitive to the genotypic and even many of the phenotypic characteristics of the individuals to whom they apply (MacDonald, 1983, 1986d, 1987a). For example, individuals may be drafted into the military or obliged to pay taxes to support individuals on welfare whether or not they want to do these things. Entire classes of individuals or even whole populations may be subject to the social controls, so that they may be quite insensitive to genetic variation. Social controls are thus not reducible to the genetic characteristics of individuals.

Social controls may be egalitarian or antiegalitarian. Egalitarian social controls function to limit the extent by which individuals can differ from each other, such as socialist controls on the individual accumulation of wealth. Antiegalitarian social controls function in the opposite manner, to accentuate individual variation in resource control or other biologically relevant phenotypes. The important theoretical point is that there are no means derived from sociobiological theory to predict whether in a particular case social controls will be egalitarian or antiegalitarian. The direction and extent of social controls is a chronic political issue in all societies, and, for example, in our society there is no theoretically derived way of predicting changes in social controls brought about by the electoral process. Sociobiology emerges as an explanatory framework for human behavior that is nonpredictive and is based on descriptions of actually existing human societies. There is no basis for the claim that sociobiological theory predicts that oppression, sexism, etc., are inevitable aspects of human social organization.

Particularly important here are social controls regulating family life. Perhaps one of the best examples is that of modern China which, in contrast to its dynastic past, has severe controls on reproduction. Of greater importance are social controls which have effectively institutionalized monogamy in Western European society since the Middle Ages and increasingly in all modern industrial societies (MacDonald, 1983, 1986a). Stone (1977) describes social controls on marriage and sex that occurred in the Puritan era in England, controls that functioned to strictly regulate family life. Laws against bigamy have been present in the United States since colonial times, and resulted in repression of polygamy as practiced by the Mormon church. From a theoretical perspective these social controls function as an egalitarian leveling institution which effectively dampens sexual competition among males.

We have now provided a framework derived from sociobiological theory within which the correlational data on family structure and reproductive ritual can be illuminated. This theoretical perspective can be expanded to also include affective relationships within the family. As described above, the correlational data indicate that societies characterized by the economically independent nuclear family have been found to have affectively warm parent-child and husband-wife relations. They are also characterized by relatively low economic production and, for the reasons described above, low levels of sexual competition. As indicated in the previous section, there are theoretical reasons for supposing that this situation is primitive in humans. With increasing levels of production the independent family unit becomes more enmeshed in extensive kinship networks, and the resulting tension between the individual and the group is reflected by increasingly hostile intrafamilial affective relationships. This negative affective climate is reflected in the male initiation rites characteristic of these societies (Paige & Paige, 1981). Paige and Paige (1981) also point out that violence and feuding among kin groups are common and that large conflicts of interest occur even in groups of closely related kin. In these intermediate-level societies affective relationships within the family become severely strained as each male strives to integrate himself into the wider network of kin, often in competition with his own family members. Paige and Paige (1981) state that "every man is a potential head and, therefore, also a potential traitor to his lineage. In the words of an Arab proverb, 'I against my brother; I and my brother against my cousin; I, my brother and my cousin against the next village; all of us against the foreigner'" (p. 128). This passage indicates the affective strains associated with such a social system, and also shows quite clearly that the principle of inclusive fitness did not originate with twentieth-century evolutionary theorists.

We conclude, then, that in societies based on extensive kinship relations the source of military and economic power is also the potential or actual opposition: Without a higher level of centralized political control feuds are endemic. A brief review of some of the correlational literature brings these points into sharper focus (see also Draper & Harpending, this vol., Chap. 12, and Blain & Barkow, this vol., Chap. 13). Katz and Konner (1981) found that fathers tended to be closer to their children in cultures "where combinations of polygyny, patrilocal residence, the extended family, or patridominant division of labor are absent" (p. 203). Violent and hypermasculine behavior are associated with father distance, and Bacon, Child, and Berry (1963) found father distance associated with violent crime and extremely punitive disciplinary measures with children. Aloof husband-wife relationships are also associated with polygyny and military activity on the part of the husband.

The historical trends in the past 500 years in Western Europe have been toward a decreasing importance of extensive kinship relations

associated with the resurrection of the economically independent nuclear family (Stone, 1977). Stone (1977) notes the tendency for the state to view kinship relations as a threat to its own power, as well as the tendency for individuals to cease relying for the protection of their interests on kin when the state could perform this function. The state thus destroyed the power of large kinship groups and reinforced the patriarchal nuclear family.

These changes in family structure, resulting in part from social controls on marriage and kinship relations, were accompanied by trends toward an emphasis on affective ties as being the basis of marriage and a trend toward warmer parent-offspring relationships in the period following 1640 (Stone, 1977; see discussion in MacDonald, 1987a). The history of familial affective relations is thus far from linear, and recent and contemporary familial interactions represent a return to the affective environment more characteristic of the earliest stages of human evolution. Whereas the evolutionary basis of monogamy and affectively warm family interactions occurring at the hunter-gatherer level appear to have resulted from natural selection for increased paternal investment, the return to this style of interaction may well be the result of the social controls on reproduction described above. The institutionalization of monogamy as the result of social controls on male reproduction resulted eventually in a more egalitarian family structure and increased emphasis on affective relationships as the basis of marriage.

It is interesting to note the parallels between the evolutionary considerations described here and those emphasized by Draper and Harpending in their work (see this vol., Chap. 12). Both chapters view the explanation of the cross-cultural correlational data on family interactions and reproductive strategy as central and both view economic resources as essential to an understanding of the phenomenon. In addition, both approaches stress the sensitivity of human behavior to contextual variation, particularly variation in resource base. However, the two theories provide different evolutionary explanations for this variation. They propose that the variation is a learned response to variation in resource availability (see Chap. 12 for details). The approach of this chapter, however, sees the resource base as affecting behavior primarily through its effects on sexual competition and by forcing males to participate in much wider social groups than the nuclear family. Increased production is seen as putting strain on nuclear family social structure and pulling males into the wider network of more distantly related kin. On the one hand, this results in socialization for more distant affective relationships within the family as intragroup aggression and hostility increase (see below), and on the other hand it leads to polygyny and less psychological availability of fathers for their children. This approach need not characterize this psychological distance as indicating a general lack of paternal investment. Indeed, fathers in many of these

mid-level societies are forced to make heavy economic investments in their offspring because they must in effect purchase their wives as well as maintain their economic and political status in the community. Moreover, the stress on social controls as influencing family structure and relationships in industrial societies (see above) is consistent with warm affective familial relationships and high paternal investment, whereas relying solely on resource availability to explain reproductive strategies results in predicting that industrial societies should be characterized by extreme lack of paternal investment. The opposite, however, is the case. The resource availability theory also has difficulty with the fact that within industrialized societies there is a direct correlation between socioeconomic status and paternal investment (see Draper & Harpending, this vol., Chap. 12). In general, however, these considerations illustrate well the fact that human sociobiology is a theoretically and empirically diverse area. As in any science, such diversity is a sign of vitality.

IMPLICATIONS FOR DEVELOPMENTAL MECHANISMS

There are three theoretical reasons to suppose that the environment is crucial in producing cross-cultural variation in behavior. First, as argued above, many of the mechanisms involved in human social behavior are environment-expectant. These systems program for the response to expected environmental variation, so that it is reasonable to suppose that environmental variation can affect variation in adaptive phenotypes. As indicated above, environment-expectant genetic systems have the potential of providing a very quick adaptive response to environmental variation, but also allow for the possibility of pathological environmental effects—the double-edged sword of plasticity (Lerner, 1984; MacDonald, 1985).

Second, given that the epigenetic system is sensitive to environmental variation, variation in the intensity of environmental stimulation is expected to facilitate the production of extreme phenotypes (MacDonald, 1986c). The early experience literature indicates quite clearly that environments that depart radically from cultural norms are relatively likely to have long-term effects on children. From a cross-cultural perspective, this suggests that cultures facing particular ecological contingencies would be able to establish relatively extreme modal environments which would have major effects on adaptive behaviors. Indeed, anthropologists (e.g., Weisner, 1984) have often pointed out that the range of environmental variation is likely to be much wider in cross-cultural samples than within one culture. For example, in an American sample late weaning may be 18 months of age, while in a cross-cultural sample this may represent the low end of the variation. This implies that conclusions about the role of family environments should not be

based solely on the results of studies within one culture. Within a particular culture, family environments may be fairly homogeneous so that family studies fail to find significant between-family sources of environmental variation. Indeed, the result of a great many behavioral genetic studies on families indicates that between-family sources of environmental variation are not a significant source of phenotypic variation (e.g., Rushton, Littlefield, & Lumsden, 1986). These findings do not preclude a major average effect of family environment due to the modal type of parent-child relations prevailing in a particular society. These considerations are directly analogous to the principle that there can be a large average effect on IQ resulting from adoption into a middle-class environment that is not reflected in the correlational patterns between biological and adoptive relatives in an adoption study: The average effects of parenting may not be reflected in individual differences in a large, relatively homogeneous sample, but will be an important source of variation between populations (MacDonald, 1986b). Nor do the behavioral genetic findings preclude important effects of relatively extreme parent-child interactions found either cross-culturally or within a culture.

Finally, Lumsden and Wilson (1981) have shown that genetic change which influences cultural variation can occur in as little time as 1000 years. This suggests that if significant change can be shown in a shorter time period there is presumptive evidence that the source of change is environmental in origin. The fact that considerable historic evidence indicates a major shift in familial affective relationships within a period of 200 to 300 years associated with the rise of the economically independent nuclear family suggests that the shift was due to a shift in the modal environment characteristic of the population (MacDonald, 1984, 1987a). These considerations do not imply that all or even most of the cross-cultural variation in, e.g., prosocial behavior or aggression is environmentally determined but strongly suggest this possibility. Since prosocial behavior and aggression are such important human phenotypes, it is reasonable to suppose that cultures would seize the opportunity provided by human plasticity to shape this behavior in an adaptive manner.

Correlational studies done within Western societies have suggested an association between familial affective interactions and childrens' prosocial behavior and aggression. Briefly, these studies have shown that warm familial interactions are positively associated with measures of prosocial behavior and negatively associated with aggression, while cold, hostile, and rejecting familial interactions have the opposite associations. (For reviews, see Maccoby & Martin, 1983; Mussen & Eisenberg-Berg, 1977; Parke & Slaby, 1983; Radke-Yarrow, Zahn-Waxler, & Chapman, 1983; Staub, 1978, 1979, 1986). In addition, warm parent-child interactions appear to facilitate children's conformity to

adult attitudes and behavior as indicated by the literature on adolescent identity formation (MacDonald, 1987a) as well as altruistic behavior (Clary & Miller, 1986; MacDonald, 1984; Rosenhan, 1970). These results indicate a strong interactions between affectively warm parent-child interactions and social learning: Warm parent-child interactions appear to facilitate the adoption of parental attitudes and behaviors. The emphasis placed on affective interactions here does not imply that other types of environmental variations are unimportant, but merely focuses on one source of variation which appears important in the cross-cultural literature.

The discussion of the cross-cultural data on familial affective interactions presented above leads one to suppose that economically intermediate societies characterized by extensive kinship relations and high levels of sexual competition are typified by cold, hostile interpersonal relations and socialization for aggression and lack of prosocial behavior. At the lowest level of economic organization social structure is characterized by independent nuclear families, affectively warm intrafamilial interactions, and socialization for high levels of prosocial behavior and low levels of aggression. Socialization for prosocial behavior within these relatively independent nuclear family units would be adaptive because of the high degree of relatedness and common interests among the members. As the family becomes more enmeshed in extensive kinship groups characterized by high levels of sexual competition, a relatively low degree of genetic relatedness and common interest, and the concomitant violence and feuding mentioned above, socialization for aggression and lack of prosocial behavior become more adaptive (see MacDonald, 1984, 1986d, 1987a for extended discussions).

There is good reason to suppose that affectively warm familial interactions represent an optimal developmental environment in industrial societies in the sense that such environments are associated with upward mobility (see below for a discussion of the importance of social mobility as a dependent variable in sociobiological analysis). Stone (1977) points out that warm familial relationships were characteristic of the upwardly mobile middle classes in England in the period from 1600 to 1800, and Kagan (1979) suggests that more child-oriented patterns of child rearing arose as a result of the importance of instrumental competence in achieving upward mobility. In addition, phenotypes such as juvenile delinquency and teenage pregnancy which predispose to downward mobility are characterized by negative affective environments (see MacDonald, 1987a, for a review). Finally, the general tenor of much of the attachment literature suggests that socially desirable behaviors such as social popularity and ego-resilience are associated with responsive, sensitive care giving (see, e.g., Sroufe, 1979).

II. Centrifugal Tendencies Within Families and Their Effects on Children

In the previous section, although the emphasis was on the mechanisms holding the family together, there was also mention of forces, such as the possibility of polygyny and the need for males to integrate themselves with an extensive kinship group, which pulled the nuclear family into larger forms of social organization. Fundamentally, this centrifugal force results from differences in reproductive strategy between males and females, and in the present section these differences are explored with respect to their implications for families within modern industrial societies, especially as regards the social mobility and socialization of children.

The sociobiological analysis of modern industrial societies presents a number of difficulties. Although there is undoubtedly continuing natural selection within these societies against a variety of behaviors such as those typical of schizophrenia (MacDonald, 1986d), unlike traditional societies there is no evidence for an association between control of resources and reproductive success (Barkow & Burley, 1980; MacDonald, 1983; Vining, 1986). This situation may be due to a variety of factors, including especially social controls on marriage and family structure (MacDonald, 1983; 1986d) and the need for increased parental investment in a relatively low number of highly competent children in a highly competitive society (Alexander, 1979). An attractive alternative to the use of Darwinian fitness as the major dependent variable in sociobiological analysis is the use of socioeconomic status and social mobility as dependent variables. The assumption is that high social class status and optimal cognitive and social functioning are inherently desirable from a sociobiological viewpoint because of their association with wealth and political power which in traditional societies are strongly associated with Darwinian fitness (Dickemann, 1979; Hartung, 1976; Hill, 1984; Irons, 1979; MacDonald, 1983). In the jargon of the philosophy of science, these relationships in traditional societies as well as basic evolutionary theory provide empirical and theoretical support for the contrary-to-fact conditional that if there were no social and ideological controls on marriage and sex in modern industrial societies, there would in fact be a strong association between social status and reproduction. The support of theoretically derived contrary-to-fact conditionals is an aspect of all scientific theories (e.g., Aronson, 1984) and in the present case justifies an interest in socioeconomic status and social mobility as dependent variables in a sociobiological analysis. In the same manner, psychological data and theory generate contrary-to-fact conditionals such as "If this child were adopted into a middle-class family, his IQ would be above average" which are theoretically

and empirically justified whether or not adoption in fact becomes a social policy.

A second reason for using socioeconomic status as a dependent variable here is that high socioeconomic status facilitates sociobiologically predicted behavior even within industrial societies. As we shall describe below, wealthy males are able to mitigate the decrements in their children's adaptive behavior which are expected as a result of divorce.

Modern industrial societies are characterized by a variety of social and ideological controls which reinforce monogamy. However, in recent years there has been a secular trend toward decreasing social controls on divorce, with the result that the incidence of divorce has increased dramatically. From a sociobiological point of view divorce and remarriage constitute serial polygamy, and the consequences of this serial polygamy are expected to be quite different for the two sexes. Since males remain reproductively competent longer than females, they are expected to benefit from divorce by being able to marry younger women, a situation that is facilitated if the male is of high socioeconomic status. Females, however, are expected to be less likely to benefit from divorce because of lessened reproductive value and because they must generally increase their relative share of parental investment after divorce. This situation is exacerbated if the woman is of low socioeconomic status. Moreover, it is expected that divorce will generally result in a decrease in parental investment in children with concomitant decreases in culturally adaptive behavior. From a sociobiological perspective, these decrements are secondary results of males' engaging in sociobiologically predicted behavior.

The data on divorce generally uphold these expectations. First, women have a longer average duration of divorce before remarriage than men, and this is particularly true for older women (Mackey, 1980). Seventy-six percent of divorced women up to age 29 remarry, while only 32.4% remarry between ages 40 and 49, and only 11.5% between 50 and 75 (Mackey, 1980). Divorced males more often remarry and they tend to marry women who are increasingly younger than themselves (Mackey, 1980). Moreover, divorce tends to result in economic decrements for women, part of the recent "feminization of poverty." This increasing poverty results in downward social mobility for women and the children of the first marriage following divorce (Hetherington, 1979; Wallerstein & Kelly, 1980). Downward social mobility is often accompanied by movement to less desirable neighborhoods and is much more severe and permanent than that experienced by men (Wallerstein & Kelly, 1980).

The developmental literature on divorce indicates moderate impairments associated with divorce due either to father absence or to the negative home environment prior to divorce. Boys tend to show continuing problems with teachers and peers and are characterized as aggressive and noncompliant (Hetherington, 1979; Hodges, Buchsbaum, &

Tierney, 1983; Hodges & Bloom, 1984). Guidubaldi, Cleminshaw, Perry, and McLoughlin (1983) found significant performance decrements in social and intellectual performance in a random sample of elementary school children from divorced homes when compared to intact families (see also Hetherington, Camara, & Featherman, 1983; Wallerstein & Kelly, 1980). Wallerstein and Kelly (1980) also document emotional difficulties in postdivorce children, and several studies suggest difficulties in sex-typing for both sexes (Hetherington, 1966, 1972; Huston, 1983), as well as antisocial, delinquent behavior in boys (Guidubaldi et al., 1983; Hetherington, Cox, & Cox, 1982). Finally, data indicate that a much higher percentage of stepfathers engage in child abuse than natural fathers (Burgess, Garbarino, & Gilstrap, 1983; Daly & Wilson, 1981) and that there are often long-term psychiatric impairments for the children involved. From a sociobiological perspective sexual abuse by a stepfather is expected to occur at relatively high rates because of the lack of biological relationship between stepfather and daughter, but in the present context it is also an example of the decrease in parental investment and concomitant decrements in adaptive behavior that are associated with divorced and reconstituted families. As predicted by sociobiological theory, stepparents as a group invest less in stepchildren than biological fathers invest in their children (Hetherington, 1987).

It should be noted that a divorcing male can mitigate the effects of divorce by providing for his children economically. Wallerstein and Kelly (1980) found less downward mobility in divorced women of the upper and upper-middle classes and also found that poor psychological outcome in children was associated with economic distress (see also Hodges et al., 1979). Thus, high social class status facilitates sociobiologically predicted male reproductive behavior by lessening its consequences on children. Moreover, in addition to economic support, fathers can lessen the effects of divorce by maintaining a good relationship with their children after divorce (Guidubaldi et al., 1983), i.e., by maintaining a fairly high level of parental investment.

Finally, as indicated above, there have been important secular trends and cultural variation in the social controls affecting divorce. Divorce has increased greatly in the United States in recent years, an increase that is associated with decreasing legal and social restrictions on divorce, such as no-fault divorce laws. Divorce is still not legal in Ireland and was virtually impossible in England from 1603 to 1837 (MacFarlane, 1986). Recently women's groups have attempted to improve the status of women in divorce settlements by enforcing child-support laws and by making the ex-husband's professional degree and future earnings part of the divorce settlement. Thus contextual variation on social controls can have a very profound effect on sociobiologically predicted sexual behavior and secondarily on the socialization of children.

III. Conclusion

The central message of this essay is in many ways a familiar one to developmentalists. The science of human development must adopt a multivariate, contextual perspective, what Lerner and Kauffman (1986) term the *embeddedness* of behavior. One must invoke different levels of analysis (social controls, proximate mechanisms), various biological systems (affective bonding versus biological self-interest), and the interfaces of these biological systems with environmental contingencies such as the interface between the affective systems and social learning (MacDonald, 1984, 1987a). As illustrated by this essay, a sociobiologically influenced developmental psychology will be vitally concerned with historical shifts in the contextual variables affecting behavior as well as with how these variables function as part of a cross-cultural theory of variation in development. Indeed, at the present time sociobiological theory is the only theory that is powerful enough to provide an explanatory framework for the descriptive data generated by cross-cultural and historical studies of human development.

REFERENCES

- Ainsworth, M., Blehar, M.C., Waters, E., and Wall, S. (1978). *Patterns of attachment*. Hillsdale, NJ: Erlbaum.
- Alexander, R.D. (1979). *Darwinism and human affairs*. Seattle: University of Washington Press.
- Aronson, J.L. (1984). *A realist philosophy of science*. New York: St. Martin's Press.
- Bacon, M.K., Child, I.L., and Berry, K. (1963). A cross-cultural study of the correlates of crime. *Journal of Abnormal and Social Psychology*, 66, 291–300.
- Barash, D.P. (1977). *Sociobiology and behavior*. New York: Elsevier North-Holland.
- Barkow, J., and Burley, N. (1980). Human fertility, evolutionary biology and the demographic transition. *Ethology and Sociobiology*, 1, 163–180.
- Berlyne, D. (1960). *Conflict, arousal and curiosity*. New York: McGraw-Hill.
- Bowlby, J. (1969). *Attachment*. New York: Basic Books.
- Bowlby, J. (1973). *Separation*. New York: Basic Books.
- Brazelton, B., Koslowski, B., and Main, M. (1974). The origin of reciprocity: The early mother-infant interaction. In M. Lewis & L. Rosenblum (Eds.), *The effect of the infant on its caregiver*. New York: Wiley.
- Bronfenbrenner, U. (1986). Ecology of the family as a context for human development. *Developmental Psychology*, 22, 723–742.
- Burgess, R., Garbarino, J., and Gilstrap, B. (1983). Doing what comes naturally? An evolutionary perspective on child abuse. In D. Finkelhor, R.J. Geller, G.T. Hotaling, & M.A. Strauss (Eds.), *The dark side of families: Current family violence research*. Beverly Hills, CA: Sage Publications.
- Clary, E.G., & Miller, J. (1986). Socialization and situational influences on sustained altruism. *Child Development*, 57, 1358–1369.

- Daly, R., & Wilson, M. (1981). Abuse and neglect of children in evolutionary perspective. In R.D. Alexander & D.W. Tinkle (Eds.), *Natural selection and social behavior*. New York: Chiron Press.
- Dickemann, M. (1979). Female infanticide, reproductive strategies, and social stratification: A preliminary analysis. In N. Chagnon & W. Irons (Eds.), *Evolutionary biology and human social behavior*. North Scituate, MA: Duxbury Press.
- Dickemann, M. (1981). Paternal confidence and dowry competition: A biocultural analysis of purdah. In R.D. Alexander & D.W. Tinkle (Eds.), *Natural selection and social behavior*. New York: Chiron Press.
- Goody, J. (1976). *Production and reproduction*. New York: Cambridge University Press.
- Gray, J., Owen, S., Davis, N., & Tsaltas, E. (1983). Psychological and physiological relations between anxiety and impulsivity. In M. Zuckerman (Ed.), *Biological bases of sensation seeking, impulsivity, and anxiety*. Hillsdale, NJ: Erlbaum.
- Guidubaldi, J., Cleminshaw, H.K., Perry, J.D., & McLoughlin, C.S. (1983). The legacy of parental divorce. *School Psychology Review*, 12, 300-323.
- Hartung, J. (1976). Natural selection and the inheritance of wealth. *Current Anthropology*, 17, 607-622.
- Hetherington, E.M. (1966). Effects of paternal absence on sex-typed behaviors in Negro and white preadolescent males. *Journal of Personality and Social Psychology*, 4, 87-91.
- Hetherington, E.M. (1972). Effects of father absence on personality development in adolescent daughters. *Developmental Psychology*, 7, 313-326.
- Hetherington, E.M. (1979). Divorce: A child's perspective. *American Psychologist*, 34, 851-858.
- Hetherington, E.M. (1987, April). Presidential address, Society for Research in Child Development Meetings, Baltimore, MD.
- Hetherington, E.M., Camara, K.A., & Featherman, D.L. (1983). Achievement and intellectual functioning of children from one-parent households. In J. Spence (Ed.), *Achievement and achievement motives*. San Francisco: Freeman.
- Hetherington, E.M., Cox, M., & Cox, R. (1982). Effects of divorce on parents and children. In M. Lamb (Ed.), *Non-traditional families*. Hillsdale, NJ: Erlbaum.
- Hill, J. (1984). Prestige and reproductive success in man. *Ethology and Sociobiology*, 5, 77-95.
- Hodges, W.F., & Bloom, B.L. (1984). Parents' reports of children's adjustment to marital separation: A longitudinal study. *Journal of Divorce*, 8, 33-50.
- Hodges, W.F., Buchsbaum, H.K., & Tierney, C.W. (1983). Parent-child relationships and adjustment in preschool children in divorced and intact families. *Journal of Divorce*, 7, 43-58.
- Huston, A.C. (1983). Sex-typing. In P. Mussen (Ed.), *Handbook of child psychology*, Vol. 4. New York: John Wiley.
- Irons, W.C. (1979). Cultural and biological success. In N. Chagnon & W. Irons (Eds.), *Evolutionary biology and human social behavior*. North Scituate, MA: Duxbury Press.
- Kagan, J. (1979). Overview. In J. Osofsky (Ed.), *Handbook of infant development*. New York: John Wiley.

- Katz, M.M., & Konner, M.J. (1981). The role of the father: An anthropological perspective. In M. Lamb (Ed.), *The role of the father in child development* (2nd ed.).
- Lerner, R.M. (1984). *On Human Plasticity*. New York: Cambridge University Press.
- Lerner, R.M., & Kauffman, M.B. (1986). The concept of development in contextualism. *Developmental Review*, 6, 309–333.
- Lumsden, C.J., & Wilson, E.O. (1981). *Genes, mind, and culture*. Cambridge: Harvard University Press.
- Maccoby, E., & Martin, J. (1983). Parent-child relationships. In P. Mussen (Series Ed.), and E.M. Hetherington (Vol. Ed.), *Handbook of child psychology*. Vol. 4. *Socialization, Personality and Social Development*. New York: Wiley.
- MacDonald, K.B. (1983). Production, social controls and ideology: Toward a sociobiology of the phenotype. *Journal of Social and Biological Structures*, 6, 297–317.
- MacDonald, K.B. (1984). An ethological-social learning theory of the development of altruism: Implications for human sociobiology. *Ethology and Sociobiology*, 5, 97–109.
- MacDonald, K.B. (1985). Early experience, relative plasticity and social development. *Developmental Review*, 5, 99–121.
- MacDonald, K.B. (1986a). *Civilization and Its Discontents* revisited: Freud as an evolutionary biologist. *Journal of Social and Biological Structures*, 9, 213–224.
- MacDonald, K.B. (1986b). Early experience, relative plasticity and cognitive development. *Journal of Applied Developmental Psychology*, 9, 101–124.
- MacDonald, K.B. (1986c). Developmental models and early experience. *International Journal of Behavioral Development*, 9, 175–190.
- MacDonald, K.B. (1986d, May). The plasticity of human social organization and behavior: Contextual variables and proximal mechanisms. Paper presented at a conference entitled “Evolutionary constraints on human culture,” UCLA, Los Angeles, CA.
- MacDonald, K.B. (1987a). Biological and psychosocial interactions in early adolescence: A sociobiological perspective. In R.M. Lerner & T.T. Foch (Eds.), *Biological and psychosocial interactions in early adolescence: A life-span perspective*. Hillsdale, NJ: Erlbaum.
- MacDonald, K. (1987b). [Review of *Symbiosis in parent-offspring interactions*, edited by L. Rosenblum & H. Moltz.] *Developmental Psychobiology*, 20, 477–484.
- MacFarlane, A. (1986). *Marriage and love in England, 1300–1840*. London: Blackwell.
- Mackey, W.C. (1980). A sociobiological perspective on divorce patterns of men in the United States. *Journal of Anthropological Research*, 36, 419–430.
- McCall, R. (1981). Nature-nurture and the two realms of development: A proposed integration with respect to mental development. *Child Development*, 52, 1–12.
- Mussen, P. & Eisenberg-Berg, N. (1977). *Roots of caring, sharing and helping*. San Francisco: Freeman.
- Paige, J.E., & Paige, J.M. (1981). *The politics of reproductive ritual*. Berkeley: University of California Press.
- Panksepp, J. (1986). The psychobiology of prosocial behaviors: Separation, distress, play and altruism. In C. Zahn-Waxler, E.M. Cummings, & R. Iannotti

- (Eds.), *Altruism and aggression: biological and social origins*. New York: Cambridge University Press.
- Parke, R.D., & Slaby, R.G. (1983). The development of aggression. In P. Mussen (Ed.), *Handbook of child psychology*, Vol. 4. New York: Wiley.
- Pulliam, H.R., & Dunford, C. (1977). *Programmed to learn*. New York: Columbia University Press.
- Radke-Yarrow, M., Zahn-Waxler, C., & Chapman, M. (1983). Children's prosocial dispositions and behavior. In P. Mussen (Ed.), *Handbook of child psychology*, Vol. 4. New York: Wiley.
- Rosenhan, D. (1970). The natural socialization of altruistic autonomy. In J. Macauley & L. Berkowitz (Eds.), *Altruism and helping behavior*. New York: Academic Press.
- Rushton, J.P., Littlefield, C.H., & Lumsden, C.J. (1986). Gene-culture coevolution of complex human social behavior: Human altruism and mate choice. *Proceedings of the National Academy of Science*, 83, 7340-7343.
- Sahlins, M. (1974). *Stone-age economics*. Chicago: Aldine.
- Sroufe, L.A., (1979). Socioemotional development. In J. Osofsky (Ed.), *Handbook of infant development*. New York: Wiley.
- Staub, E. (1978). *Positive social behavior and morality, Vol. 1: Personal and social influences*. New York: Academic Press.
- Staub, E. (1979). *Positive social behavior and morality, Vol. 2: Socialization and development*. New York: Academic Press.
- Staub, E. (1986). A conception of the determinants and development of altruism and aggression: Motives, the self, and the environment. In C. Zahn-Waxler, E.M. Cummings, and R. Iannotti (Eds.), *Altruism and aggression: Biological and social origins*. New York: Cambridge University Press.
- Stein, L. (1983). The chemistry of positive reinforcement. In M. Zuckerman (Ed.), *Biological bases of sensation seeking, impulsivity and anxiety*. Hillsdale, NJ: Erlbaum.
- Stern, D. (1977). *The first relationship*. Cambridge, MA: Harvard University Press.
- Stone, L. (1977). *The family, sex and marriage in England: 1500-1800*. New York: Harper and Row.
- Trivers, R. (1972). Parental investment and sexual selection. In B. Campbell (Ed.), *Sexual selection and the descent of man*. Chicago: Aldine.
- van den Berghe, P. (1979). *Human family systems*. New York: Elsevier.
- Vining, D.R. (1986). Social versus reproductive success: The central theoretical problem of sociobiology. *Behavioral and Brain Sciences*, 9, 167-216.
- Wallerstein, J., & Kelly, J.B. (1980). *Surviving the breakup*. New York: Basic Books.
- Weisner, T.S. (1984). Ecocultural niches of middle childhood. In W. A. Collins (Ed.), *Development in middle childhood*. National Academy Press.
- Wilson, E.O. (1975). *Sociobiology: The new synthesis*. Cambridge, MA: Harvard University Press.
- Wohlwill, J. (1973). *The study of behavioral development*. New York: Academic Press.
- Zuckerman, M. (1983). A biological theory of sensation seeking. In M. Zuckerman (Ed.), *Biological bases of sensation seeking, impulsivity, and anxiety*. Hillsdale, NJ: Erlbaum.

12

A Sociobiological Perspective on the Development of Human Reproductive Strategies

PATRICIA DRAPER and HENRY HARPENDING

Overview

A current view in the human sciences emphasizes an understanding of the individual as a representative of a past history of selection for survivorship and reproduction. All of us are descendants of individuals who lived long enough to produce reproductive offspring. Our current generation represents the variable mating success of our ascendants. Some of our grandparents and great grandparents had many offspring, others had only one or two. At each generation there are new opportunities to expand and to contract the genetic contribution of particular individuals to future generations. Since evolution favors those (1) who survive and (2) who are most successful at reproduction, we expect Darwinian theory to be most immediately helpful for comprehending our survivorship, mating, and parenting, while it may be less immediately applicable to domains like religion that are less intimately tied to fitness. In the case of humans, for whom learning plays a central role in differentiating reproductive success from failure, the social circumstances and social lessons we experience play a substantial role in influencing our reproductive behavior, the number of offspring we have, and the manner in which we rear those offspring. Learning also contributes to the social niche we occupy during the lifespan. Attention therefore is increasingly focused by sociobiologists on the evolution of human learning. While learning is “intangible” in a practical sense, it becomes analytically and conceptually more corporeal when we consider the fact that *what* individuals learn contributes deterministically to reproduction and differences among individuals in reproduction. In this chapter we wish to consider the relationships among human reproductive behavior, learning experience, and the social institutions of the society in which the individual matures. Our approach differs from more usual social science analysis in that we do not assume temporal and functional interdependence among these variables. We are as interested in *why* there are functional interdependencies as in the fact and the shape of those that do exist.

Humans show a great deal of variability in their reproductive behavior, including types of sexual activity, types of ties between males and females, and ways of arranging for the rearing of offspring. We will consider three principal topics: (1) Father absence versus father presence, contrasting children who are reared in a family system in which there is a closely involved and economically contributing father in contrast to a family system in which women rear their children in cooperation with other women (usually kin) and without consistent help from a man who is father to children. (2) Peer rearing versus parent rearing, concerning who does the primary work of rearing children—whether biological parents themselves and in a proximate sense provide for the care of their own children or whether parental surrogates do the major child tending work under some form of distal parental supervision. (3) Pair-bonding between parents versus individual strategies that do not include reciprocation with a mate, with a view toward understanding several psychiatric “disorders” as manifestations of more general evolved propensities against cooperation.

In the first two cases we discuss the consequences which being reared under one or the other of these conditions can have for the individual's reproductive strategy. For simplicity we portray the conditions as dichotomous alternatives but we recognize that in actual life individual experience can vary along a continuum from one to the other. There are data on these topics, and evolutionary theory can help us understand these patterns in a way that takes account both of environmental differences among groups and the evolved characteristics of our species.

The evidence about why some adults seem to prefer to bond with one individual of the opposite sex while others mate in quite different contexts is quite sketchy. We will discuss characteristics of sociopaths and hysterics, individuals with clusters of traits identified by psychiatrists and usually interpreted as victims of mental illnesses. We will point out that these trait clusters seem to make good sense when considered in the light of the evolutionary theory of reproductive strategies, even though there is no good evidence of learning or of effects of rearing environment on their development.

Our view of learning is that humans have been selected to be differentially sensitive to certain cues in their immediate early childhood environment (Bowlby 1969, 1973; Lumsden & Wilson, 1981; MacDonald, 1984). It is as if human young acquire early socialization with their antennae tuned to detect certain attributes in their environment, especially the role played by mother's mate and the mother's attitude to her mate(s), and the role of parents as opposed to nonparental surrogates in providing proximate care in early childhood. These are examples of contextual variables which influence learning tracks in early childhood (MacDonald, this vol., Chap. 1) and which can be understood in the context of our evolutionary past. A fuller account of the

hypotheses and the supporting assumptions and evidence is provided later in this chapter.

We also consider reciprocity and cooperation in everyday interactions among individuals. It is probably *not* true that the most reproductively successful people in the past were those that were the most cooperative and altruistic, because others could have taken advantage of model citizens. Yet reciprocity is the foundation of human social life: we expect that there will be a rich array of learning biases and manipulative abilities in our species in this domain. Some humans seem to be more likely to cheat than others, but it is not clearly known whether the propensity is a product of genes or of the learning environment. Further, human males and females who cheat do it in sensibly different ways. We discuss this more below in the section on "Criminality and Hysteria." Whether learned or not, the "cheating model of sociopathy and hysteria" is a good model of the potential for evolutionary reasoning to broaden our understanding of behavioral diversity in our own species, and we believe it worth covering in some detail even in the absence of good information about mechanisms.

Introduction

Sociobiology has had a difficult time becoming established in the social sciences because of entrenched ideas that human adaptation is primarily by means of culture and that culture is learned. Some call it an extrasomatic form of adaptation. Whereas it is relatively easy to convince social scientists of the inherent utility of Darwinian logic as applied to nonhuman animals, it is not so easy when it comes to humans. Humans, after all, rely on learning for everything that is significant about human adaptation. Furthermore, humans differ markedly from each other in customs that enable group survival, but perhaps even more in customs that seem to have little relationship to group survival.

For example, human economic practices are highly variable—they include simple foraging by people living in small kin groups, as well as simple food production systems at higher densities, and may involve more complex leadership roles such as chiefs and ritual leaders. Peasant social systems with high degrees of social stratification are more familiar to contemporary people. Still more exotic are the economic and political forms of postindustrial society. Marriage and family forms are heterogeneous across societies of varying degrees of complexity as are fertility regimens, which vary from, at, or near replacement levels (Western societies) to fertility rates which produce population doubling in 20 years (modern Kenya and Afghanistan).

Given this diversity, how can it be argued that humans like other animals have been biologically programmed? Many draw what seems the obvious conclusion: humans differ profoundly from nonhuman animals. Tissue and bone may be homologous structures but developments in the human evolutionary line have led to qualitative differences in the organization and potential of our species. We are unique, particularly with respect to the morphology of the greatly enlarged brain and in the critical role played by postnatal learning in enabling our adaptation to the environment. There are several things wrong with this approach.

LEARNING, ADAPTATION, VARIABILITY

1. Humans are not unique in the animal kingdom in the role played by individual learning in explaining individual survival and differences among individuals in survival and reproductive success (Durham, 1976). Research among mammalian social species and in particular the higher primates (monkeys and apes) reveals the critical role of postnatal learning in individual development. We also understand the degree to which individuals in nonhuman animal populations vary among themselves in behavioral strategies both in dealing with conspecifics and in dealing with other organisms and features of their environment. Long-term research on a variety of social mammalian species that employs techniques of behavioral observation has revealed that each organism may play a specialized social role contingent upon his or her own life history, availability of resources, relations with other members of the social group, and other factors (Altmann, 1980; Dublin, 1983; Silk & Boyd, 1983; Wrangham, 1980).

SPECIES CONTEXT OF LEARNING

2. We now realize that the individual organism does not come equipped with a generalized capacity to learn "anything" in the way of responses to cues that are coupled with consistent rewards and punishments. Instead, there is a growing understanding of the fact that natural selection has shaped the central nervous system to promote the "ease of learning" of certain responses which themselves are conducive to the survival and ultimately the reproduction of the individual.

The easiest example of so-called learning propensities has occurred to anyone who has had a child and, at any time, a kitten. Kittens learn about cat litter after being placed there once—they find it very easy to learn. Humans, on most grounds better learners than cats, have no such easy time with the human equivalent of cat litter.

The psychologist John Garcia is known for bringing the subject of evolved ease of learning into experimental psychology. In experiments

with rats, he showed that they very quickly and easily learned to avoid a certain drink if they were (artificially) made nauseous after consuming it. If they were punished instead with electric shock in association with eating they *did not learn to avoid the food*. Similarly, the punishment of electric shock taught them easily to respond to lights, but nausea did not condition the response to lights. It seems obvious, in retrospect, that a well-designed rat would associate foods with nausea and external stimuli with external pain, but it was not so obvious to many psychologists (Garcia, McGown, & Green, 1972; Konner, 1982). The ease with which we learn idiosyncratic food aversions after their accidental association with nausea or digestive disorder is called the *Garcia effect*. The general principle is that the Garcia effect is an example of a *learning rule*.

Another example of learning predispositions which reflect preadaptation to an evolutionarily expected environment is the effect which the human face (or a schematic representation) has in capturing the attention of newborn infants (Ahrens, 1954; cited in Freedman, 1974). The face is apparently a "natural cue" indicating that neonates are born with some neurological structures in place which determine that some unconditioned cues are inherently more rewarding than others.

RENEWED INTEREST IN HUMAN SIMILARITIES

3. Human cultural variability no longer seems as extreme as it once did. Instead, we are becoming less impressed with differences of complexity, density, and technology in different human populations and more aware of how humans are basically similar, at least with regard to fundamental behaviors which are central to Darwinian fitness. This is not to diminish the very substantial and interesting differences which humans exhibit with respect to practices regarding competition, sexuality, mating, and parenthood. However, as we understand more about the factors which condition the variability in social and reproductive behavior in nonhuman animal species, we are led to new inquiries about humans.

An instructive example comes from studies of species which show facultative shifts in mating behaviors. The changes away from a baseline of practices common to a population in a particular region may be occasioned by such changes as availability of resources, predator density, density of conspecifics, etc. Under resource-scarce conditions, wolves form heterosexual packs of several reproductively mature individuals as well as subadults (Packer & Pusey, 1984). However, only one pair typically reproduces. Other subordinates do not engage in sexual behavior. On the other hand, when conditions permit pack dispersal, these same subordinates form pairs and rear offspring. Some individuals in a bird population normally characterized by monogamy

will shift over to polygynous unions when foodstuffs become unexpectedly abundant (Emlen & Oring, 1977; Verner, 1964). In this case males compete for territorial control of rich areas and several females accept the territory-controlling male as mate, forgoing his parental help in lieu of the improved foraging conferred by locating their nests in his territory. Similar examples are abundant in the animal literature. (See Weatherhead & Robinson, 1979).

As can be seen from these examples, with an improved understanding of the complexity and subtlety of nonhuman animal adaptation it is possible to understand human behavioral variability as not totally different in kind (Barkow, 1980; Chagnon & Irons, 1979; Kurland, 1979; van den Berghe, 1980). In the context of cross-species comparison, human sciences have acquired another dimension, the evolutionary one. What kind of biopsychological creature are we? What past environments have our phylogenetic ancestors passed through which have created selective funnels for the transmission of various traits having to do with physiology, morphology and behavioral response?

Scholars who wish to apply evolutionary logic to human behavior operate at an inherent disadvantage. We are a long-lived species, which means that it is next to impossible to determine in the present time what may be the long-term consequences of a particular behavior by an individual or a group. In addition, our knowledge is limited regarding the types of selective pressures our ancestors encountered. We have the contemporary phenomenon of several billion humans pursuing a variety of careers and goals, but how is sense to be made of this? We need an informed evolutionary biology for the social sciences, something analogous to the baleen used by whales in separating the tiny but nutritious krill from thousands of gallons of seawater.

Learning Biases

We think that a road map to clarity will be built from a new theory of learning. There are many ways to classify learning, and there are concepts like "reflex" that some would call learning and some not. We want to mention here a way of thinking about learning and the relationship of learning to evolution that has been stated most clearly by Boyd and Richerson (1985). Learning mechanisms can be distinguished according to whether or not they are *cheap and easy* or *expensive and hard*, as well as according to whether they are *biased* or *unbiased*. Then, our task becomes understanding what kind of learning mechanism will evolve under what circumstances, when testing this understanding against empirical data about human learning. This is the so-called *deductive* approach to science, and it is the one that has historically worked in most fields. The *inductive* approach would be to try to classify learning

according to our scholarly investigation of its manifestations without direction from a preexistent theory. Such a classification might not bear a relationship to the (evolutionary) mechanisms that generated our learning capacities.

Easy learning, or *social learning*, is inexpensive passive absorption of what is being observed or taught. Perhaps the best example is that of language learning in childhood: children typically learn to speak without being taught and they learn a close approximation to what they hear. Contrast this inexpensive, painless learning with, say, learning multiplication tables or calculus. It is hard to avoid the conclusion that we are designed to learn language and that we learn it by a rather special mechanism that does not generalize easily to other domains.

Why doesn't this easy learning generalize? For an answer, we have to consider the social and natural environment in which we evolved and consider the costs or disadvantages of easy learning. One obvious disadvantage of easy learning is that, if the environment changes, we might learn outdated information and not do as well as another individual who learned up-to-date information, albeit with greater cost.

For example, a learning rule that directed a young male to learn, as easily as he learns language, the subsistence behaviors of his father, would be strongly disfavored in the event of a change in the subsistence base of the group. A committed hunter would do poorly if the only food available were fish. It is probably always advantageous to speak the language of the group, but it may often be advantageous to prefer to learn subsistence practices *different* from those of others, since there would be less competition for them.

A second more subtle disadvantage of easy learning is that we might be taught information that was ultimately contrary to our own best interests by less than benevolent conspecifics. An easy learner would be too gullible for his or her own (reproductive) interests. Since we reproduce sexually, our offspring are not genetically identical with us, they have different (reproductive) self-interests, and a child too readily indoctrinated by his or her parents would not do as well, over the long term, as a child who was less gullible. For example, optimized parents would try to teach their children to treat other siblings better than the level of sibling altruism optimum for the child (Trivers, 1974).

The opposite of social learning or easy learning is expensive, hard learning that requires substantial amounts of time, energy, or risk. The advantages and disadvantages mirror those of easy learning discussed above—hard learning is more careful, discriminating, and less prone to error. It seems that hard learning is the natural state for learning for many human activities, in that it seems to be hard for our species to learn evolutionarily novel things like algebra or assembly language.

Biased learning refers to the learner's preferences and propensities filtering the material presented and available for learning. This is

broadly synonymous with *prepared* learning. For example, in the face of very similar classroom experiences males seem to learn certain kinds of spatial tasks more readily than do females, while females outperform males in certain linguistic domains. These learning biases, further, are affected by physiological processes, especially those apparent during early development (Ehrhardt & Baker, 1974). There is probably much to be learned about biased learning in the domain of moral learning and the learning and development of social skills in general. (See this vol., Chaps. 4 & 5). Many humans are *taught* to be much more altruistic, honest, and moral than they actually are as evidenced by their behavior. Unfortunately, much of our knowledge in this domain is about what people *say* on questionnaires and in interviews rather than about what they actually *do* in their everyday lives.

In terms of the original goals that we discussed, we now propose that certain classes of reproductive behavior are the result of interaction between learning biases and particular experiential and institutional configurations experienced by individuals.

Father Absence

An advantage of sociobiological analysis is that it represents a higher order or more inclusive framework within which the data of the social sciences may be reexamined. By asking the question "What fitness gains may return to individuals who behave one way as opposed to another?" one gains a new kind of leverage in understanding why certain learning experiences seem to produce a given outcome. We believe that the diversity of outcomes of father absence and presence makes a great deal of sense when it is considered in the framework of sensitive-period learning of reproductive strategies (Draper & Harpending, 1983).

We suggest that natural selection has favored a learning bias in children for the acquisition of reproductive style. The activation of this learning bias depends on contextual cues in the environment, and these cues are associated with the mother's pair-bond status. We do not know nor have we theoretical reasons for predicting *what precisely is the mechanism* which triggers the learning track "chosen" by the child. Further research particularly of a type for which social learning psychologists are well suited will be necessary. (See Blain & Barkow, this vol., Chap. 13.) The rationale behind the suggestion of learning bias for reproductive strategy is as follows: Humans have multiplied rapidly since the end of the Pleistocene and have spread in the last 40,000 years into a wide range of physical environments. In the process of this geographic dispersal humans have generated a wide diversity of social environments which have changed rapidly in time and in space. The social environments themselves have evolved, perhaps in response to

the nature of essential resources and the availability of them. As a result, any set of human genetic material has been exposed to a diversity of social environments over the most recent tens of thousands of years, and certainly the fitness of individuals in many human societies is more dependent upon social skills than upon skills in manipulating the extrasocial environment. This unstable diversity of social environments is precisely the context where phenotypic plasticity would enjoy the greatest advantage over any fixed strategy (Cavalli-Sforza, 1974).

If prolonged practice and attention is required for the successful function of some activity in adulthood, and if at the same time there is general environmental variability changing through time, but changing slowly compared to the scale of an individual lifetime, then the optimum mode of adaptation may be to establish early in development a learning track which guides later learning and practice. Humans are unusual in the extent to which their behavior remains open, i.e., capable of being channeled through learning. It seems that human mating behavior, while clearly constrained fairly sharply by factors not susceptible to modification by learning, is "open" within a range, so that an individual can "choose" a reproductive style which is appropriate in the metric of fitness to aspects of the social environment perceived in early life.

THE ROLE OF MALES

In considering the diversity of human cultures, we have divided them into those that are, in our terms, father-absent and those that are father-present. This dichotomy is, of course, not the only way to classify cultures, but it is a classification that proceeds from a prior theory about human behavior. Our father-present societies correspond to what Whiting and Whiting (1975) called *intimate* societies, referring to the nature of the relationship between spouses. Our father-absent societies are the *aloof* societies of Whiting and Whiting and they correspond closely to societies with the "male supremacist complex" of Divale and Harris (Divale & Harris, 1976; Whiting, 1965; Whiting & Whiting, 1975). The difference between these two types of society is a difference in male reproductive strategy, and the correlates that we and others have observed follow from this difference in strategy. In this section we outline some of these correlates and then discuss why males should follow one or the other of their strategy alternatives.

Biologists understand that diploid organisms commit a certain fraction of their resources to reproduction (as opposed to growth, maintenance, etc.) and that this *reproductive effort* can be partitioned into *mating effort* and *parental effort* (Kurland & Gaulin, 1984). Mating effort is the expenditure of resources in obtaining access to a sexual partner, while parental effort is the expenditure of resources in parental care. Female mammals have high obligate parental effort compared to males,

because of internal fertilization, internal gestation, and lactation. Male mammals, on the other hand, show more variability in reproductive effort, ranging from the domestic labor of the beaver to the belligerent mating battles of elephant seals.

This variability in male reproductive strategy has a close human counterpart. Human males can act like dads, working at provisioning the young of a mate or mates (but usually one), or else they can act like cads, and work at maximizing sexual access to a large number of mates (Dawkins, 1976). Of course, males are opportunistic and most males probably pursue some mixture of pure strategies that varies over the life course. Nevertheless, father-present societies are those where most males act like dads and father absent societies are those where most males act like cads.

Correlates of these two kinds of society are as follows:

- Father-absent societies are particularly prevalent in so-called middle-range societies, i.e., those where agriculture is practiced at a very low level of intensity and there is low human population density. The father-absent complex is also found among hunter-gatherers in rich stable environments like the American Northwest Coast and among the lowest socioeconomic groups in industrial cities (the “underclass”: see Banfield, 1968). Father-present societies are more likely to be found among hunter-gatherers in harsher or less stable environments, among densely packed agricultural peoples (“peasants,” Asian wet-rice cultivators), and in industrial societies (“working class” and those above).
- A marker of father-absent societies is that husbands and wives do not sleep and eat together, while in father-present societies they do (Whiting & Whiting, 1975).
- Father-absent societies are associated with local raiding and warfare, while father-present societies are associated with external warfare or else imposed peace. The local raiding is often for purposes of capturing women.
- Public relations between men and women are hostile and antagonistic or else carefully avoided in father-absent societies, while relations are more relaxed and intimate in father-present societies.
- There are more likely to be high levels of male violence in father-absent societies, especially public, highly visible violence associated with male display by means of colorful costumes, ornaments, etc. Male style in this context has been labeled *protest masculinity* by some psychologists. This local-level violence may also be directed at women.
- Male public bombast, oratory, and rhetoric are more prevalent in father-absent societies. Speech and language are primary vehicles for male competition.
- Bonding between males and females is more transient in father-

absent societies, and the prevalence of polygyny is higher. Social forms of marriage may not reflect the underlying mating system.

- There is a pattern of abrupt termination of parental care in father-absent societies, characterized by intense nurturance by the mother followed by sudden cessation of maternal interest at (fairly early) weaning. Toddlers are then cared for by siblings and other children, fostered out to older female relatives, or both. This pattern is accompanied by high fertility and, often, high levels of weaning and toddler mortality (Harpending, Draper, & Pennington, in press; Fonseca, 1986; LeVine, Correa, & Tapia Uribe, 1986; Scheper-Hughes, 1985).
- When a woman adopts this kind of mating style it has direct consequences for her maternal investment in offspring. A woman who provides domestic and sexual services for a man can expect some continuity in the relationship. However, a better "hold" on her man comes when she produces a child which he and others in the community recognize as his own (Fonseca, 1986; LeVine, et al., 1986; Oppong & Bleek, 1983). This strategy, of course, contributes to high levels of fertility since offspring seem to be required for the maintenance of the union, however brief. The woman's new mate does not welcome the idea of supporting her offspring by previous unions; these she typically fosters out to her own or the children's father's kin. Thus, the pattern of low male investment and accompanying father absence goes hand in hand with reduced maternal investment per child. In natural fertility populations a woman usually keeps her child until it is weaned or through early childhood, when the entrance of a new boyfriend begins the cycle anew.
- In father-present societies male subsistence labor is high and directed toward provisioning of a mate and offspring. In this context females (or their families) who perceive early that male parental effort is important to their reproduction will be more careful and reticent at adolescence in forming sexual relationships and will form more stable pair bonds. In father-absent societies there is little direct provisioning of mate and offspring by males. Women often provide the majority of subsistence labor. These father-absent females recognize that male parental effort is not crucial to reproduction and they are less coy and reticent, engage in sexual activity earlier and with less discrimination, and form less stable pair bonds (Schneider, 1961; Draper & Harpending, 1982).
- Women who mate with cad males recognize that they cannot be relied upon for substantial economic support or long-term commitment to the pair bond. Consequently, one finds in the literature describing father-absent societies that women devalue the male parental role and, where they are not constrained by restrictive mores, they form transient liaisons with various men. Women try to capture economic resources from their mates *early* in the sexual relationship since they know that *later* the man will be either gone or improvident.

Ideally we would at this point, specify why some cultures fall into the father-absent pattern and some into the father-present pattern, but we do not have any clear and explicit theory. A clue is provided by the comparative study of mating systems in birds and animals: we should look at the fitness payoff to the male subsistence work versus the fitness payoff to male competition.

If there is abundant food, then a male does not benefit from provisioning his offspring to the extent that he does if food is scarce, so the payoff to male labor must be a crucial element in our theory. But "payoffs" are filtered through the human perceptual system, so that how resources are perceived is part of the corpus of culturally transmitted behavior of our species. What we can say is that competitive, fractious males are *acting as if resources were plentiful* regardless of our own objective evaluation of resource availability (Draper, in press).

It is not easy to discern cause and effect in the dynamics of this system. For example, the urban underclass in industrial cities fits our model of father-absent societies in many ways: there are decorative, belligerent, highly verbal males, matrifocal families not provisioned by a mate, high levels of fertility and (relatively) low-grade parental care, fostering, and adoption (Belsky & Draper, 1987). But the underclass has fewer, not more resources, than other socioeconomic groups! It may be that the culturally transmitted *perception* of resource structure determines underclass membership: the so-called working class (Banfield, 1968), the economic neighbors of the underclass, is characterized by values and behavior that fit our father-present model. We need a meaningful model of the evolution of human perceptual strategies to sort all this out.

Elsewhere in the world the fit between more objective estimates of resource structures and our model seems better. Father-absent hunter-gatherers are found in rich ecosystems (Northern Australia, New Guinea, the Northwest Coast of North America) in comparison with father-present hunter-gatherers (!Kung Bushmen, Shoshone). And father-absent agricultural peoples are found at low densities where subsistence can be provided by female labor alone (Amazon basin swiddeners, the African "female farming systems" of Boserup, 1970), while father-present agriculturalists are characterized by higher densities and more labor-intensive agricultural practices (Asian wet-rice cultivators, European peasants).

We discuss this matter at greater length below when we consider the demographic transition in European history as a transition from a father-absent pattern to a father-present pattern.

SOCIAL SCIENCE DATA ABOUT FATHER ABSENCE

We think that data from the social sciences about the effects of being reared father-present versus father-absent represent a complex series of

conditions which occur in early childhood and are an example of contextual variables which trigger reproductive outcomes which are not fully expressed until later in the child's life. Our analysis draws on the findings of psychologists and sociologists but differs in that it attempts to explain *why* the experience of being reared father-absent or father-present seems to produce the outcome. The following is a brief review of the findings from the father-absence literature.

Father-Absent Boys

It has been widely reported that boys reared in father-absent households are different from their peers reared in nuclear families. The actual behavioral contrasts between the two kinds of boys vary somewhat according to the cultural environment and according to whether father absence is nonnormative (as among middle-class people in Western societies) or whether it is normative (as in the case of some traditional, non-Western societies in which polygynous marriages, weak marital ties, and strong sex-segregating practices serve to isolate women and children from men).

Father-Absent Boys: Nonnormative

Boys reared in Western type societies by mothers and with little or no influence from fathers do more poorly in school, are less likely to have the analytic and mathematical skills common to boys, show less popularity with peers (Biller 1970; Lynn 1974), reject authority, particularly when it is imposed by adult females, and have a more aggressive behavioral style (Miller, 1958) sometimes interpreted as "overcompensation" for insecure masculine sex-role identification (Whiting, 1965). As they age they adopt attitudes that denigrate females and at adolescence they often develop a precocious sexual interest in girls, an interest which emphasizes sexual conquest of many girls rather than the establishment of more durable and intimate relations with one girl (Rohrer & Edmunson, 1960).

Boys reared under Western, normative father-present conditions are less likely to exhibit these characteristics. When tests are available they are more likely to show the typical masculine pattern in which scores on tests of spatial and analytic ability are superior to test scores on verbal ability. Boys reared by investing fathers are not notably resistant to authority, have good relations with male peers, and have generally positive attitudes toward women. They are more likely to delay sexual experience, discriminate in their choice of females, and to have non-exploitative relations with women.

Father-Absent Boys: Normative

For a reader not familiar with the structuring of marital relations in father-absent societies we provide a brief explanatory digression. In order to follow this discussion the reader needs to put aside his/her own preconceptions about what the terms *father*, *fatherhood*, and *marriage* imply. In societies in which fathers are emotionally and psychologically aloof from women and children there are, nevertheless, family roles which correspond formally to those of Western, nuclear families. That is, women marry men and conceive children by these men who are socially recognized as fathers to their children. Usually the fathers are also genitors of their children. However, prevailing customs regarding the division of labor and relations between the sexes are such that men and women, with their young children, have limited personal and social contact, even though the marriages that tie men and women may be durable. Many prestate, tribal-level societies are like this, as indicated in a previous discussion.

The outcomes for boys who are reared under conditions of normative father absence are not precisely comparable, particularly since formal schooling is often not available to provide comparable social contexts or opportunities to observe cognitive factors. However, many of the behaviors we see are the same even though there is nothing unusual about father absence in these societies.

The following is a list of behaviors and practices characteristic of males in societies which we would class as normatively father-absent: High levels of aggression and competitive display among males, usually including much bombast and rhetoric and occasionally including outright physical violence; sex-role asymmetry, in which male dominance and female subordination are pervasively established in secular and sacred spheres of social organization; and sex-role antagonism, by which we mean that men and women hold stereotypically negative and hostile attitudes toward the opposite sex (Schuster, 1979; Murphy & Murphy, 1974; Meggitt, 1964; LeVine, 1959; LeVine & LeVine 1966; Whiting & Whiting, 1975).

Girls

Girls, regardless of father absence or presence, do not show a consistent pattern on cognitive tests. Instead, girls show verbal ability scores on standard tests which are typically superior to test scores of quantitative ability and especially spatial ability. Also, since girls are nearly always reared by adult females, they do not lack appropriate sex role models which enhance correct sex role identification. However, at adolescence some father-absent girls differ from controls in the domain of sexual behavior. Variables which have been studied include attitudes toward

males and masculinity, interest in sexuality, timing of appearance of sexual interest, and interest in developing a stable relationship with one male.

Father-Absent Girls: Nonnormative

In general, father-absent girls show precocious sexual interest, negative attitudes toward masculinity and males, and poor ability to maintain sexual and emotional adjustment with one male (Bloss, 1969; Friedman, 1969; Hetherington, 1972; Rainwater, 1971).

Father-present girls at adolescence are unlikely to show the above constellation of traits. They are slower to acquire sexual experience, choosier in selection of boyfriends, and make what Western sociologists think of as correct and normal progress toward the formation of durable pair bonds.

The effect of being reared under conditions of father absence or presence apparently influences reproductive behavior including sexual expression, timing of sexual expression in individual ontogeny, and attitudes toward the opposite sex. The association between the contextual variable (household structure or mother's attitude toward men) and later behavior occurs with regularity and in a variety of cultural environments. It is apparently not the result of a fortuitous coincidence between modal family type and sexual mores across settings. For example, Hetherington (1972) reports that divorced mothers in her American lower-middle-class sample were shocked and dismayed by their daughter's "precocious" sexual interest. (See Barglow, Bernstein, Exum, Wright, & Visotsky, 1968, for similar report.)

Father-Absent Girls: Normative

Interestingly enough, the sequelae of being reared father-absent in normative father-absent societies are not very visible, given the current state of ethnographic reporting on the behaviors of females. In traditional society, a young female is often married either at puberty or prepubertally (Whiting, Victoria, & Burbank, 1986). In this case her sexual conduct is moot, since her sexual union is regularized and culturally approved. The young woman typically has married a man considerably older than she. As a bride she finds herself incorporated into the sex-segregated domestic life of other women who are related by marriage to her husband. These women may be her co-wives or the sisters or mother of her husband. Any sexual adventures she might be tempted to initiate will be inconvenienced by the vigilance of these other women, who have varying interests in the reproductive potential of a newly in-married woman. Co-wives already regard an additional wife as a drain on the single husband's ability to provide for multiple wife and offspring

sets, and they cannot be expected to turn blind or benign eyes on their rival's infidelity. The mother-in-law has obvious reasons for keeping her daughter-in-law in check: the older woman wants her son's children to be her own grandchildren (Dickemann, 1981).

In many traditional societies, then, females are unable to express what we posit to be the reproductive effects of their own father-absent rearing. Evidence for cross-sex antagonism is, however, not hard to find. (See Potash, 1978; Levine & Levine, 1966; Stack, 1974). They marry early and their reproductive careers begin without controversy under the strictures of a sexual double standard in which females trade personal autonomy in return for the social and physical security which comes with the status of married women.

The fact that father-absent rearing in fact has robust effects on reproductive behavior is suggested by the current tendency toward unwed, teenage pregnancy both in low socioeconomic groups in complex societies and in Third World countries, for example sub-Saharan Africa. Various factors work to exacerbate the quandary. Falling menarcheal age, improved nutrition, and perhaps other public health practices result in a secular trend toward earlier age at first menstruation for girls. Even accounting for months or years of adolescent sterility, the effect is to move down in chronological age the risk of pregnancy (Lancaster, 1986).

As education becomes more widely available and prerequisite for jobs in the modernizing sector of the economy, women who previously may have married at 15 years of age delay marriage until their late teens or early twenties. Further, school-age girls associate with younger men, closer to age mates, who are in a poor position to act as fathers and husbands when a pregnancy is begun. The same modernizing influences which have brought about improved public health, reduced epidemiological risk factors, formal schooling, and youthful migration to urban areas also impair the ability of elder kinsmen to control the sexual activity of adolescent girls (Kayongo-Male & Onyango, 1984; Peil & Sada, 1984; Obbo, 1980). The result is dramatically increased rates of childbearing among young women. The "problem" attains awesome proportions when one realizes that in some countries 50% of the population is under 15 years of age.

It should be stated that, except as declining menarcheal age extends the age range of individuals at risk, teenage pregnancy is not new or unnatural. What is new and unnatural is the lack of social provision for the consequences of youthful sexuality. In the very recent past nubile girls were quickly removed from the mating marketplace by senior males who attempted to control their sexual behavior in order to insure paternity. The male age mates of the prized young females were forced into either celibacy or relatively infertile matings with older or unattached women. Young men whose sisters married early could expect to

wait another 10 or 15 years before marrying. During the hiatus, many of these junior men were lost to migration, warfare, death, or morbidity in competition with other males, often over women (Dickemann, 1979).

The Demographic Transition

Anyone interested in the interface between evolutionary biology and human social behavior has to confront the last few centuries of demographic history of Euro-American industrial nations, the so-called demographic transition (Vining, 1986; Draper & Harpending, 1987; Caldwell, 1977). This is the decline in both death rates and fertility rates in the eighteenth, nineteenth, and twentieth centuries, with the result today that in Western industrialized countries, large numbers of people, those with great access to resources necessary for survival and reproduction, voluntarily reduce the numbers of their offspring. This pattern is remarkable since one might expect humans, like any other species, to respond to an improved environment with increased fertility.

We refer specifically to industrial upper-, middle-, and working-class families, who enjoy extremely favorable conditions in terms of health, food, political stability, and numerous "free" social services ranging from public education and public health services, to stable currency. But these groups have switched to the strategy of producing small numbers of "quality" offspring rather than larger numbers of "lower quality" offspring. "Quality" here refers to the amount of parental resources invested in each offspring, the consequent probabilities that offspring will survive to maturity, and the ability of offspring to compete with conspecifics through education, heritable wealth, land, etc.

The fertility decline is an empirical finding, but little is known about why it occurs. What perception on the part of fertile couples could bring about the behavior, and what proximate mechanisms could trigger the changed perceptions of the state of the environment leading to such a fundamental change in reproductive strategy? The answer is not as obvious as it might seem when one recalls that in the same complex, socially stratified postindustrial societies, different groups show different patterns of fertility. The most obvious difference is between the high fertility associated with the lowest socioeconomic groups and low fertility among the more affluent groups. What estimate of the state of current and/or future resources are people making, and with reference to what qualities of the environment are people arriving at these estimates?¹

¹The Hutterites are an instructive example of an affluent social group in which fertility remains high by present-day world standards (Hostetler, 1974).

Reflecting their assumption that the rest of the world will undergo the same change in demographic configuration, demographers refer to *pre-transition* societies as those found today in many parts of the Third World, where populations exhibit extremely high fertility in the face of what by objective measures appear to be extremely limited resources. People in these societies have a reproductive strategy which emphasizes numbers rather than quality of offspring. High fertility persists with a falling but still significant mortality. The outcome is steadily increasing population size, putting staggering demands on national and local communities.

At the local level land, water and access to markets become limited. At the national level shortages occur as governments are unable to satisfy demands for education, employment, public health, and economic development, which in turn could help the country absorb the growing and increasingly restive labor force. As we did above, we can ask about perceptions of environmental quality among people pursuing a high fertility strategy and about which proximal mechanisms trigger these perceptions. As many fail to appreciate, the fertility behavior of modern people is not without precedent. There are other populations living under very different kinds of socioeconomic organization who also show the "modern" pattern. These cases are extremely instructive for those of us who would hope to understand the influence of institutions on individual reproductive behavior.

Our current fertility pattern of low mortality and low fertility is not "new," for it has had a long run as the preferred human fertility pattern in prehistoric times (Cohen, 1980; Short, 1976; Lancaster & Lancaster, 1983). Before the advent of agriculture and animal husbandry, world population was extremely low and increased at an extremely slow pace (Hassan, 1980). At this time the prevailing economy was nomadic hunting and gathering. Group size was small (probably between 50 and 100 individuals) and social differentiation was extremely limited, amounting in many cases to social divisions based essentially on no more than age and sex. Comparison of the patterns of marriage, fertility, and parenting behaviors at the two ends of the range of sociocultural complexity (hunter-gather and postindustrial society) reveals some surprising similarities. For example, there are in both groups low fertility, low mortality, monogamous marriages, high biparental investment in children, and prolonged, intimate and intense contact between parents and children (Briggs, 1970; Draper, 1976; Howell, 1979; Kaplan, Hill, & Hurtado, 1984; Lancaster & Lancaster, 1983).

The pretransition pattern (which we are arguing is a transient intermediate stage of cultural evolution) is characterized by a drastically different constellation of reproductive patterns: marriages are typically polygynous, or temporary, or both, norms stress pronatalism as a necessary antidote to high child mortality, parental investment per child is

low, especially after infancy, and contact between children and their parents is less intense, intimate, and prolonged. Surrogate caretakers, often older children but also a series of foster parents, living in different communities provide the alternative care for children in pretransition societies.

We suggest that this variation in fertility behavior among different populations is itself a cue to the presence of evolved learning biases related to fertility behavior. In other words, humans share with some other animals an ability to regulate their reproduction, not only on the basis of present essential resources, such as food and freedom from stress, but also on the basis of cognitions about the long-term quality of the environment. For humans and other social species, the institutions that regulate kinship, mating, and subsistence are important shapers of the perceptual estimation of environmental quality.

What is the nature of the stimuli with which individual humans deal and what role can they play in the assessment of environmental quality by an individual? For humans, postnatal learning determines many of the options available. We suggest that a fruitful place to look for environmental stimuli that can influence the individual's estimation of environmental quality is the experiences individuals have in the early years of life. We focus on a restricted time period, namely, the toddler phase, but experiences before and after this developmental stage are presumably also influential. We argue that the postnatally perceived environment of the individual will vary according to the nature of the parenting practices which support that individual in his/her dependency. In their turn, the perceptions of environmental resources will influence the person's reproductive behavior at sexual maturity. The human postnatal environment is mediated through social institutions and technology. Some institutions will foster cognitions of adequacy or abundance in resources; other institutions may foster a cognition of scarcity of relevant resources.

Under ancient hominid conditions, a prominent part of the environment for parents and dependent offspring must have been each other. At that time, just as today, the young required years of prolonged care, and the mother herself was the one who delivered the bulk of the care. This kind of pattern is described for most contemporary hunter-gatherer groups. Because of the small size of the groups, the nomadism, and the lack of alternatives to mother's milk for nourishing young, the mother and her mate would have been the primary target of succorance requests by the child. This kind of child played a major and active role in sustaining a high level of parental investment. Even though other group members could assist the parents it would be unlikely that a system of substantial surrogate caretaking would develop. The parents, particularly the mother, were the significant caretakers of children under about 4 years of age. An especially important point for the argu-

ment we are developing is this: the mother could not elude her offspring. The parents could abandon or neglect a child and in this way terminate investment. On the other hand, the parent could not readily delegate major caretaking responsibility to others in the first several years of the child's life. This child was in a position to regulate actively parental care.

PARENT REARING

As above when we argued that the effects of father absence reflect learning bias for sensitivity to mother's pair bond status, we propose that the child who is nurtured primarily by the parent(s) develops a distinctive set of cognitions about his/her environment. These cognitions contrast with those of a child who is reared by surrogate parents, or, especially, by a multiaged and variable group of peers.

The parent-reared child operates in a world populated by significant, powerful others whose size and status are markedly different from those of the child. The parents and their adult surrogates are few in number and relatively stable in composition. The child who must negotiate essential goods and services from the same, small number of powerful others (the parents) may conclude that goods are hard to obtain. Because of the status difference between parent and child, the child spends relatively little time in dominance struggle and competitive manipulation of other people. This child knows where resources can be obtained, and they are handed over increasingly as the child masters adult competence. This attribute is important because the child is *not* learning that desirable things are held by a loose congregation of others whose goodwill must be maintained by constant social attention. We predict that a consequence of this rearing environment is that it teaches the child an essentially conservative approach to the evaluation of apparent resources.

PEER AND SURROGATE REARING

The social, emotional, and economic landscape traversed by children in many pretransition societies is different in major respects (Bledsoe & Isiugo-Abanihe, in press; DuBois, 1944; Fonseca, 1986; Korbin, 1981; Murphy & Murphy, 1974; Ritchie & Ritchie, 1979; Scheper-Hughes, 1985; Scrimshaw, 1978; Weisner, 1987). One of the most detailed descriptions of this pattern is found in Polynesia. According to the Polynesian practice, when the child has passed the stage of infancy and requires less intensive care, it is not only turned loose for the daylight hours but is also actively discouraged from putting too many demands on the parents. The child is discouraged from hanging too close to its mother, and instead, is supposed to join a multiaged peer group. Often

he/she is assigned to a particular older child who provides much of the care previously provided by the parent: feeding, dressing, disciplining, protecting. The peer group is changeable in size and composition but we argue that the characteristics of peers as socializers have implications for the cognitions that the child forms about the quality of environmental resources.

We reason that children who are reared in this context learn that resources can come from a variety of persons depending upon how good the child's access to individuals in his peer network is. This kind of child garners resources in proportion to his ability to manipulate social relations; social skills are acquired early and are important adjuncts for survival. Peer group rearing may foster an outlook in an individual who sees, regardless of objective perceptual reality, a host of potential resources based on culturally acquired evaluations and attitudes. The child reared by a parent is freed from this kind of social work and learning since his/her social skills don't pay off in food and resources the way they do in a peer group context.

In the system of peer rearing a parent is protected from attempts by the child to elicit resources, because the mother deflects onto others many of the demands posed by the child. To the extent, then, that the child's presence and physical demands on the mother constitute a significant element in her cognitions about resource adequacy, the mother whose child is segregated in this way is less inhibited by the demands of one child from conceiving another.

Parent-reared children such as those found among foragers and some horticultural groups and among relatively affluent socioeconomic classes in modern society are similar in that they have direct access to adult sponsors, usually their parents. The parent who provides for a child under these circumstances deals with a different kind of offspring—one who does not go away and who creates many and continuous demands on the parent. This condition of high offspring salience may lead to a changed cognition on the part of the parent regarding the child's "needs." Of course, objectively, children all need about the same things for basic survival. Under conditions of peer care these needs are met differently and by different people. The outcome can be satisfactory. However, the singular feature of the parent caretaker system is that the child's needs are being met by the parents; they are the focus of the child's attention and are recipients of the child's requests. The stimulus value of offspring in this situation is different. As a result, the cognitions on the part of the parents are changed regarding how to deal with children and how to provide for them.

Our model with respect to the topic of peer versus parent rearing is in many ways analogous to the model detailed in the discussion of the effects of father absence. In both cases we argue that children are differentially sensitive to certain components of their social context as a

result of evolutionarily programmed learning biases. In the father-absence case children are sensitive to mother's pair-bond status and their reproductive strategies are canalized. In the parent versus peer rearing case children are sensitive to the characteristics of the personnel who provide proximal care in the late infancy/early childhood phase. Depending on the type of care received individuals are likely to pursue a quality offspring versus quantity offspring parenting style. An advantage of our formulations, which are admittedly unorthodox, is that they attempt to specify the proximal mechanisms whereby individual behavior is shaped and they state in fitness terms why the proximal mechanisms and stimuli produce the outcomes they do.

We believe the inferences regarding interactions between institutions, proximal mechanisms, and learning bias are reasonable given the relatively limited constraints under which human reproduction and child socialization have operated in our evolutionary past. Under all known social conditions women and men establish sexual relationships of greater or lesser durability and conceive children. Depending upon the physical resources and the social conditions women may or may not require the active help of their mates in order to rear their offspring to maturity. When they do, women make sexual concessions to their mates primarily to assure paternity certainty. This "contract" generally insures that the father is salient to her and her children both because of his active presence in their domestic life and/or because the mother signals his worth to her offspring.

In the opposite case, when women do not require the help of their mates to rear offspring, they make limited or no sexual concessions to their mates, paternity is uncertain, and male salience in the domestic setting is correspondingly muted and devalued by the mother. We argue that the household structure has the predictable outcomes for children's reproductive behavior at maturity because of a learning bias favored by evolution. Children who "draw the right conclusions" from their mother's *unpaired* status have improved fitness in the type of social environment with which the mother is familiar (or the mother has prepared for them). Children do not invest time seeking durable and monogamous marriage partners. Indeed, time spent in this way would be wasted.

Children who draw the right conclusions from the mother's *paired* status are likewise headed for a fitness maximizing reproductive strategy in the alternative type of social environment prepared for them by their mothers (and fathers).

We suggest that the consequences of parent versus peer rearing are significant primarily in terms of what they convey about the adequacy of resources. Individuals who are reared by parents perceive resource scarcity and "hand rear" their offspring, a decision which both reduces fertility naturally and makes adults more amenable to artificial means

of birth control when they are known. Individuals reared by a series of parental surrogates conclude that critical resources will be forthcoming from within the social network. They perceive no “emic” scarcity, although by “etic” accounts the demographic reserves are depleted.

A further advantage of our unorthodox propositions is that they allow us to explain and predict the variability in individual behavior that occurs in apparently the same social or cultural context. As we stated above in our discussion of easy and hard learning, one can predict that with respect to behaviors as central to fitness as sexuality, mating, and parenting, the individual is best served by natural selection if he/she can learn readily certain behaviors or the potential for certain behaviors. The mother herself and the system of social support are, from the child’s point of view, the most infallible sources of information about resources, survival, reproduction, and mating.

Many years ago Freud asserted that what is learned early is learned best. We would agree with this but we would explain it differently. Cognitions acquired from learning bias and rearing effects are probably quite resistant to change. If this is so we would predict that the youth of low-income ghettos of modern stratified societies will not readily trade their “birth rights” for the secular inducements dangled by majority politicians. Nor will adults in Third World societies “see” the rationality of having fewer children as a route to a better life. Their evaluations of resource availability and the quality of life are based on a different and prior set of perceptions (Bulato & Lee, 1983). It is probably true that big changes in the behavior of large numbers of people will come about when certain key, contextual features of the experience of both men and women are changed in early life. Contemporary programs to bring about large-scale changes in reproductive behavior of adults are probably handicapped by this phenomenon of lag between individual psychologies and an objective determination of resource availability.

Criminality and Hysteria

We have been discussing how humans ought to learn about their social environment and how this learning ought to direct their further learning, other aspects of their development, and their behavior. We have also discussed the ways that evolutionary theory and data make sense together, even though people are not necessarily consciously aware of the meaning that biologists would ascribe to the choices that they make. But not all the interesting insights from evolutionary biology are about learning.

In this section we will discuss the characteristics of people who don’t follow the same rules as most of the rest of us—sociopaths and hysterics. We will describe the most clear-cut manifestations of these traits, but we

must keep in mind that they are almost certainly quantitative traits and that there are few “pure” cases. Being a sociopath is like being tall: everyone is a little bit tall, and some people are taller than others. Sociopathy and hysteria are also like stature in that most of the differences among individuals seem to be due to gene differences. We will not go over the evidence here, but there is no indication that any kind of learning is involved in the genesis of these traits, as there is with the traits associated with father absence. However, social systems differ in the extent to which they are congenial to or inimical to the spread of sociopathic individuals in a population.

Psychiatrists have a diagnostic category of sociopathy or antisocial personality disorder. There is a very big overlap between the psychiatrists’ sociopaths and what police and the courts see as habitual repeat criminals. When one looks carefully at the list of characteristics of sociopaths, it is apparent that criminality is only one of a number of traits that most of these males share. We must make sense of a whole constellation of traits if we are to understand sociopathy. Further, it is not clear that it really is a disorder. The whole idea of disorder or pathology is, of course, bound to the perspective of whoever is doing the evaluation. Sociopathy is certainly a disorder from the viewpoint of the courts and the police, but it may not be a disorder from the perspective of Darwinian fitness.

Other intriguing associations are to be found in the literature on sociopathy. Female relatives of sociopaths are at risk of showing many of the same traits as the males, but they are at much lower risk. But many of these females exhibit another psychiatric disorder, called *hysteria* or *Briquet’s syndrome*, and we have to explain why females in these families should have a quite different set of symptoms from the men.

First, let us look at the data, that is, the characteristics that mark sociopaths and hysterics. Sociopaths are (usually) males with histories of criminality, absence or low levels of apparent “conscience,” lack of long-term interpersonal bonds, verbal facility and quickness, charm, mobility, and vagrancy, promiscuity, illegitimate offspring, and abandonment of spouse and children (Cloninger, 1978; Goodwin & Guze, 1984). Notice that some of these characteristics are, at least theoretically, objective and measurable like numbers of illegitimate offspring. Others are anecdotal, like charm and verbal facility. We think that the criminality is incidental here, and that the core characteristics (i.e., the characteristics that have been the focus of selection) are the mobility, the promiscuity, and the abandoned mates and illegitimate and abandoned offspring.

The way that sociopathy and socioeconomic status interact confounds our interpretation of data here. One view is that sociopathy is much more prevalent in lower socioeconomic groups (Cloninger, 1978), but another is that low-SES sociopaths are much more likely to commit

crimes for which they are arrested and jailed. Middle- and upper-income sociopaths, according to the latter model, express the trait in ways that are less visible to the judicial and penal systems.

Briquet's syndrome (Goodwin & Guze, 1984) is a diagnostically distinct trait, almost always found in females, characterized by multiple complaints (specifically medical complaints in the medical literature), attention-seeking, sexual difficulties, promiscuity, and illegitimate offspring. It seems to be the expression in females of the same genetic material that leads to sociopathy in males (Cloninger & Guze, 1970), as if male-female differences were the result of sex differences in development of the brain (Goy & McEwen, 1980). The medical model of an hysteric female is one who suffers from multiple medical complaints, none of which correspond to anything objectively ascertainable on other grounds. These medical-hysteric females undergo "unnecessary surgery" and in other ways take of the time and attention of medical practitioners. But if, as we propose, the fundamental trait is self-dramatization and the exaggeration of need to males, then there may be females who act out the same kinds of interactions with clergyman, lawyers, politicians, etc. These would not appear in the medical literature because they would not come to the attention of physicians.

THE VIEW FROM SOCIAL THEORY

We are all enmeshed in complex networks of social reciprocity and exchange. Some of these are very public, like traffic laws, while others are private within a very small group of people. It is as true of very technologically primitive societies as it is in complex societies like ours that individual success, reproductive or other, is highly dependent on the individual's ability to manipulate and use networks of reciprocity and exchange. Different individuals, we might expect, would bring different strategies to their interactions in these networks. To pick a likely dimension, some might be more reliable reciprocators and more likely to follow the rules (implicit or explicit). The advantage of such a "nice" strategy is that it will lead to reliable high returns if practiced in a network of other nice actors and that there is little cost (in the currencies of time, energy, and risk) expended on trying to come away with a better payoff from an exchange than others have gotten. But the line between compliance and gullibility is thin, and nice strategists generally fare poorly in interactions with those not so nice.

A fundamentally different set of proclivities in social exchange, the "sharp" strategy, would consist of generally trying to outdo other participants. Those who practice the sharp strategy may ordinarily out-compete nice strategists, but they incur the costs associated with manipulating the set of social rules and expectations. Sharp strategists would prosper, we expect, when social interactions with others were

short-lived, since over time social partners would be ever better able to detect sharp strategists and avoid or constrain them. If it were possible to assess this hypothetical attribute of people, we would expect individuals to fall along a smooth spectrum from “nice” to “sharp” to “cheater” at the extreme. It is easy to see that both extremes would fare poorly in evolution: individuals who were too “nice,” who did not withdraw from exchanges where they lost, would lose in competition with those who were more discerning. Similarly, extreme cheats would find few social partners and would do equally badly.

Since we have no instrument to measure the social reciprocity proclivity of individuals, we may ask what characteristics we would expect to see in people at various points along our hypothetical spectrum. Could we make interesting or nonobvious predictions from our sketchy theory? Does our theory help us understand anything about the world that we didn’t understand before?

Let us concentrate on the “cheater” end of our continuum of proclivities. What would a human who was prone to cheat in social relationships be like? A number of predictions are immediate:

- The most obvious prediction is that there would be no easily perceptible markers of cheaters. A cheater who advertised his or her strategy wouldn’t have much of a chance of success, so we expect from the start that the traits that we seek will be subtle.
- Given the constraints of subtlety, our hypothetical cheater would be charming, outgoing, and sensitive, at least outwardly. In other words, we expect our cheater to be skilled at interpersonal manipulation.
- Since the fitness of cheating decreases in proportion to the time his or her partners have to assess his reliability in reciprocation, good cheaters would be mobile. The longer they stay in one place, the lower their success. They should move frequently or, if in dense habitats like cities, they should change their set of acquaintances frequently.
- Since most of our skills, social and otherwise, are based on years of practice and development, we expect that cheaters would practice even when there was no immediate payoff to their behavior. For example, if cheaters needed to be very skilled at telling lies, then they should practice lying even when there is no good reason. The imperative to practice may account for the seeming maladaptive behavior of individuals like those evaluated by others as “habitual liars.”
- Males and females should show fundamentally different manifestations of the underlying proclivity to cheat because the constraints on successful reproduction are very different for the two sexes. Females *must* expend a lot of time, energy, and risk in pregnancy and lactation, while males are under no such constraint. During most of human evolution female reproduction was constrained by the necessity to obtain food, while male reproduction was constrained by the necessity

to obtain sexual access to females. (These statements are true of mammals in general, because high parental effort is engineered into mammalian females with their internal gestation and lactation.)

- * Male cheaters should cheat, in the reproductive domain, on provisioning females after copulation or impregnation, that is to say they should be promiscuous and they should abandon offspring. In pursuit of this, we expect them to be especially skilled at seduction and at deceiving females about their potential to provide resources.
- * Female cheaters, on the other hand, have less to gain by seduction of males and abandonment of offspring unless surrogate caretakers are available. But female cheaters are expected to be skilled at exaggerating their needs to males and at persuading males to provide resources to them. If their fundamental orientation is to extracting resources from males, as opposed to cooperative provisioning and rearing of offspring with a mate, then occasional calculated seduction and promiscuity might further this orientation.

We now suggest that the complex of sociopathy and hysteria makes a great deal of sense of data that are otherwise puzzling. For example, the literature on penology often mentions the charm of criminals (Ballesteros, 1979). Why should criminals be charming? The evolutionary approach suggests that some criminals are just sociopaths who got caught, that the criminality was a manifestation of their underlying generalized indifference to social rules, and that the charm is an integral part of their adaptation. Sociopaths also move around a great deal in their lives (Robins, 1971). The evolutionary approach predicts that male mobility would be one of the core characteristics of cheat strategists.

Perhaps the most striking lead provided by this view of the material is the way it helps us understand hysterics, since the association between hysteria in females and sociopathy in males makes no good sense otherwise. The insight that they are exploiting males rather than bonding with them explains why they simultaneously (1) are often frigid and profess a distaste for sex, (2) are often promiscuous, and (3) have disproportionate numbers of illegitimate offspring.

There are many immediate predictions about sociopaths and hysterics that proceed from this theory. For example, we would predict that hysterics would abandon their children to kin or to adoption agencies at high rates, that they would be much more willing to mate with males who possessed wealth (as opposed to younger males with long-term good prospects for future resource accrual ability), and that they would respond to female clinicians in a fundamentally different way than they do to males. In particular, many of their symptoms should disappear. There is anecdotal evidence of this, but we have not located any serious data on the matter.

Conclusion

For many years the social and behavioral sciences have been dominated by the strong cultural paradigm which postulates that human social behavior is guided by learning and that humans can and do learn almost anything with equal facility. This paradigm acknowledged only the most pressing and obvious constraints of biology, like the need for food and water, the need for internal gestation, and the like.

A profound reevaluation has been occurring since the late 1960s, with mixed results so far. The new viewpoint emphasizes the power of our past and stresses the need to comprehend our evolved abilities, propensities, and biases in social and psychological theory. At the level of the individual the new viewpoint emphasizes evolved characteristics of the organism, while at the level of society it emphasizes the synthesis of social forms from the interactions of individuals as opposed to the older idea that social forms have to be analyzed on their own level. In particular, the new viewpoint accommodates individual selfishness, inequality among individuals, and institutionalized deceit and manipulation.

Much of the change in viewpoint involves no more or less than the relabeling of familiar phenomena. For example, we are today as likely to speak of "gullibility" as "compliance" in discussing the behavior of children. Similarly the "terrible twos" have been occasionally relabeled as "parent-offspring conflict." This change in labels is useful only insofar as it reflects a paradigm that allows us to understand individual and social phenomena that we did not previously understand, and, most important, a paradigm that allows us to predict things that we did not already know. The true proving ground of a scientific theory is not its ability to explain but to generate hypotheses which can be subjected to real tests. We emphasize this point of view here, even though in this chapter we have concentrated on a narrative account of one subset of the new viewpoint. The real work is generating and testing new hypotheses.

Our particular theme has been variation in reproductive behavior and the ramifications of this variation for other aspects of social life. We outlined two proposed learning mechanisms, or learning rules. The first was a rule about the nature of the parental bond, perceptions of this bond by the child, and subsequent tracking of learning preferences on the part of the child. Our theory is perhaps better able to accommodate extant data about father absence than are competing theories (see Blain & Barkow, this vol., Chap. 13), but much empirical work remains to be done.

We then proposed another learning rule concerning the nature of provisioning of toddlers and the subsequent development of the toddler. Toddlers in peer-rearing societies obtain resources from a network of other children, and their fitness depends (and has depended in our evolutionary past) on their ability to manipulate social relationships.

Since social networks are in effect the critical resources of peer-reared children, we propose that social and other learning during development is profoundly affected by the difference between this and biparental rearing. In particular, we suggest that biparental rearing fosters a concern with the environment rather than with people and a very conservative perception of the adequacy of the resource stream.

Finally, we discussed sociopathy and hysteria as heritable differences in reproductive strategy, emphasizing the difference between fitness consequences of these behaviors (i.e., that they are adaptations) and social and moral consequences of these behaviors (i.e., that they cause damage to many of us.) Our theory is falsifiable, since it does generate predictions that could easily be tested in field studies. Many theories and explanations in social science do not generate new predictions and are impossible to confirm or deny.

REFERENCES

- Ahrens, R. (1954). Beitrag zur Entwicklund des Physiognomie und Mimikerkennens, tiel I,II. *Zeitschrift fur Experimentelle und Angewandte Psychologie*, 2, 412-454, 599-633.
- Alexander, R. (1979). *Darwinism and human affairs*. Seattle: University of Washington Press.
- Altmann, J. (1980). *Baboon mothers and infants*. Cambridge, MA: Harvard University Press.
- Baker, S.W., & Ehrhardt, A.A. (1974). Prenatal androgens, intelligence, and cognitive sex differences. In R.C. Friedman, R.M. Richard, & R.L. Vande Wiele (Eds.), *Sex differences in behavior*. New York: Wiley.
- Ballesteros, O. (1979). *Behind jail bars*. New York: Philosophical Library.
- Banfield, E. (1968). *The unheavenly city*. Boston: Little Brown.
- Barglow, P., Bornstein, M., Exum, D., Wright, M., & Visotsky, H. (1968). Some psychiatric aspects of illegitimate pregnancy in early adolescence. *American Journal of Orthopsychiatry*, 38, 672-687.
- Barkow, J.H., & Burley, N. (1980). Human fertility, evolutionary biology, and the demographic transition. *Ethology and Sociobiology*, 1, 163-180.
- Belsky, J. & Draper, P. (1987). Adolescent parenthood, reproductive strategy, and prevention. *Transaction/Society*, (In press).
- Billar, H. (1970). Father absence and the personality development of the male child. *Developmental Psychology*, 2, 181-201.
- Bledsoe, C., & Isiugo-Abanihe, U. (in press). Strategies of child fosterage among Mende grannies in Sierra Leone. In R. Lesthaeghe (Ed.), *African reproduction and social organization*. Oxford: Oxford University Press.
- Bloss, P. (1969). Three typical constellations in female delinquency. In O. Pollak & A. Friedman (Eds.), *Family dynamics and female sexual delinquency*. Palo Alto: Science and Behavior Books.
- Boserup, E. (1970). *Women's role in economic development*. London: Allen and Unwin.
- Bowlby, J. (1969). *Attachment*. New York: Basic Books.

- Bowlby, J. (1973). *Separation and loss*. New York: Basic Books.
- Boyd, R., & Richerson, P.J. (1985). *Culture and the evolutionary process*. Chicago: University of Chicago Press.
- Briggs, J. (1970). *Never in anger: Portrait of an Eskimo family*. Cambridge, MA: Harvard University Press.
- Bulato, R.A., & Lee, R.D. (Eds.). (1983). *Determinants of fertility in developing countries* (Vols. I & II). New York: Academic Press.
- Caldwell, J. (1977). The economic rationality of high fertility: An investigation illustrated with Nigerian survey data. *Population Studies*, 31, 5–27.
- Cavalli-Sforza, L. (1974). The role of plasticity in biological and cultural evolution. *Annual of the New York Academy of Science*, 231, 43–59.
- Chagnon, N.A. & Irons, W., (Eds.), (1979). *Evolutionary biology and human social behavior: An anthropological perspective*. North Scituate, MA: Duxbury.
- Cloninger, C. (1978, August). The antisocial personality. *Hospital Practice*, pp. 97–104.
- Cloninger, C., & Guze, S. (1970). Psychiatric illness and female criminality: The role of sociopathy and hysteria in the antisocial woman. *American Journal of Psychiatry*, 127, 79–87.
- Cohen, M.N. (1980). Speculations on the evolution of density measurement and population regulation in *Homo Sapiens*. In: M.N. Cohen, R.S. Malpass, & H. Klein (Eds.), *Biosocial mechanisms of population regulation*. New Haven, CT: Yale University Press.
- Dawkins, R. (1976). *The selfish gene*. London: Oxford University Press.
- Dickemann, M. (1979). Female infanticide, reproductive strategies, and social stratification: A preliminary model. In N.A. Chagnon & W. Irons (Eds.), *Evolutionary biology and human social behavior: An anthropological perspective*. North Scituate, MA: Duxbury.
- Dickemann, M. (1981). Paternal confidence and dowry competition: A biocultural analysis of purdah. In R.D. Alexander & D.W. Tinkle (Eds.), *Natural selection and human social behavior: Recent research and new theory*. Oxford: Chiron Press.
- Divale, W. & Harris, M. (1976). Population, warfare, and the male supremacist complex. *American Anthropologist*, 78, 521–538.
- Draper, P. (1976). Social and economic constraints on !Kung childhood. In R.B. Lee & I. DeVore (Eds.), *Kalahari hunter-gatherers*. Cambridge, MA: Harvard University Press.
- Draper, P. (in press). African marriage systems: An evolutionary perspective. *Ethology and Sociobiology*.
- Draper, P., & Harpending, H. (1982). Father absence and reproductive strategy: An evolutionary perspective. *Journal of Anthropology Research*, 38, 255–273.
- Draper, P. & Harpending, H. (1987). Parent Investment and the child's environment. In J. Lancaster et al. (Eds.), *Biosocial perspectives on human parenting*. New York: Aldine de Gruyter.
- Dublin, H. (1983). Cooperation and competition among female African elephants. In S.K. Wasser (Ed.), *Social behavior of female vertebrates*. New York: Academic Press.
- Dubois, C. (1944). *The people of Alor: A socio-psychological study of an East Indian island*. Minneapolis: University of Minnesota Press.

- Durham, W. (1976). The adaptive significance of human reproductive behavior. *Human Ecology*, 4(2), 89-121.
- Ehrhardt, A.A. & Baker, S.W. (1974). Fetal androgens, human CNS differentiation, and behavior sex differences. In R.C. Friedman, R.M. Richard, & R.L. Vande Wiele (Eds.), *Sex differences in behavior*. New York: Wiley.
- Emlen, S.T. & Oring, L.W. (1977). Ecology, sexual selection, and the evolution of mating systems. *Science*, 197(4300), 215-223.
- Fonseca, C. (1986). Orphanages, foundlings, and foster mothers: The system of child circulation in a Brazilian squatter settlement. *Anthropology Quarterly*, 59, 15-27.
- Freedman, D.G. (1974). *Human infancy: An evolutionary perspective*. Hillsdale, NJ: Lawrence Erlbaum Associates.
- Friedman, S.T. (1969). Relation of parental attitudes toward child rearing and patterns of social behavior in middle childhood. *Psychology Reports*, 24, 575-579.
- Goodwin, D., & Guze, S. (1984). *Psychiatric diagnosis* (3rd ed.). New York: Oxford University Press.
- Garcia, J., McGown, B., & Green, K. (1972). Biological constraints on conditioning. In A. Black & W. Prokasy (Eds.), *Classical conditioning: Vol. 2. Current research and theory*. New York: Appleton-Century-Crofts.
- Harpending, H., Draper, P., & Pennington, R. (in press). Cultural evolution, parental care, and mortality. In A. Swedlund & G. Armelagos (Eds.), *Health and disease in transitional societies*. South Hadley, MA: Bergin and Garvey.
- Goy, R., & McEwen, B.S. (1980). *Sexual differentiation of the brain*. Cambridge, MA: MIT Press.
- Hassan, F. (1980). The growth and regulation of human population in prehistoric times. In M.N. Cohen, R.S. Malpass, & H. Klein (Eds.), *Biosocial mechanisms of population regulation*. New Haven, CT: Yale University Press.
- Hetherington, E.M. (1972). Effects of father absence on personality development in adolescent daughters. *Developmental Psychology*, 7, 313-326.
- Hostetler, J.A. (1974). *Hutterite society*. Baltimore: Johns Hopkins University Press.
- Howell, N. (1979). *The demography of the Dobe !Kung*. New York: Academic Press.
- Kaplan, H., Hill, K., & Hurtado, A. (1984). Food sharing among the Ache hunter gatherers of eastern Paraguay. *Current Anthropology*, 25, 113-115.
- Kayongo-Male, D., & Onyango, P. (1984). *The sociology of the African family*. London: Longman.
- Korbin, J.E. (Ed.). (1981). *Child abuse and neglect: Cross-cultural perspectives*. Berkeley: University of California Press.
- Konner, M.J. (1982). *The tangled wing: Biological constraints on the human spirit*. New York: Harper and Row.
- Kurland, J. (1979). Paternity, mother's brother, and human sociality. In N. Chagnon & W. Irons (Eds.), *Evolutionary biology and human social behavior*. North Scituate, MA: Duxbury Press.
- Kurland, J., & Gaulin, S.J.C. (1984). The evolution of male parental investment: Effects of genetic relatedness and feeding ecology on the allocation of reproductive effort. In D.M. Taub (Ed.), *Primate paternalism*. New York: Van Nostrand Reinhold.

- Lancaster, J.B. (1986). Human adolescence and reproduction: An evolutionary perspective. In J.B. Lancaster & B.A. Hamburg, (Eds.), *School-age pregnancy and parenthood: Biosocial dimensions*. New York: Aldine de Gruyter.
- Lancaster, J., & Lancaster, C. (1983). Parental investment: The hominid adaptation. In D.J. Ortner (Ed.), *How humans adapt: A biocultural odyssey*. Washington, DC: Smithsonian Institution Press.
- LeVine, R.A. (1959). Gusii sex offenses: A study in social control. *American Anthropologist*, 61(6), 965-990.
- LeVine, R., & LeVine, B. (1966). *Nyansongo: A Gusii community*. New York: Wiley.
- LeVine, S.E., Correa, C.S., & Tapia Uribe, F. Medardo (1986). The marital morality of Mexican women: An urban study. *Journal of Anthropology Research*, 42(2), 183-202.
- Lumsden, C., & Wilson, E.O. (1981). *Genes, mind, and culture*. Cambridge, MA: Harvard University Press.
- Lynn, D.B. (1974). *The father: His role in child development*. Monterey, CA: Brooks and Cole.
- MacDonald, K. (1984). An ethological-social learning theory of the development of altruism: Implication for human sociobiology. *Ethology and Sociobiology*, 5, 97-109.
- Meggitt, M. (1964). Male-female relationships in the highlands of New Guinea. *American Anthropologist*, 66, 204-224.
- Miller, W.B. (1958). Lower class culture as a generating milieu of gang delinquency. *Journal of Social Issues*, 14, 5-19.
- Murphy, Y. & Murphy, R. (1974). *Women of the forest*. New York: Columbia University Press.
- Obbo, C. (1980). *African women: Their struggle for economic independence*. London: Zed Press.
- Oppong, C. & Bleek, W. (1982). Economic models and having children: Some evidence from Kwahu, Ghana. *Africa*, 52(4), 15-33.
- Packer, C., & Pusey, A.E. (1984). Infanticide in Carnivores. In G. Hausfater & S.B. Hrdy (Eds.), *Infanticide: Comparative and evolutionary perspectives*. New York: Aldine.
- Peil, M. & Sada, P.O. (1984). *African urban society*. Chichester: John Wiley and Sons.
- Potash, B. (1978). Some aspects of marital stability in rural Luo community. *Africa*, 48, 380-397.
- Rainwater, L. (1971). Marital sexuality in four "cultures of poverty." In D.S. Marshall & R.C. Suggs (Eds.), *Human sexual behavior: Variation in the ethnographic spectrum*. New York: Basic Books.
- Ritchie, J., & Ritchie, J. (1970). *Child rearing patterns in New Zealand*. Wellington: A.H. and A.W. Reed.
- Robins, L.N. (1971). *Deviant children grown up*. Baltimore: Williams and Wilkins.
- Rohrer, J., & Edmonson, N. (1960). *The Eight Generation*. New York: Harper.
- Schuster, I.M.G. (1979). *New women of Lusaka*. Palo Alto, CA: Mayfield.
- Scheper-Hughes, N. (1985). Culture, scarcity, and maternal thinking: Maternal detachment and infant survival in a Brazilian shantytown. *Ethos*, 13, 291-317.

- Schneider, D.M. (1961). The distinctive features of matrilineal descent groups. In D.M. Schneider & K. Gough (Eds.), *Matrilineal kinship*. Berkeley: University of California Press.
- Scrimshaw, S.C.M. (1978). Infant mortality and behavior in the regulation of family size. *Population and Development Review*, 4, 383–403.
- Short, R.V. (1976). The evolution of human reproduction. *Proceedings of the Royal Society (ser. B)*, 195, 3–24.
- Silk, J.B. & Boyd, R. (1983). Cooperation, competition, and mate choice in matrilineal macaque groups. In S.K. Wasser (Ed.), *Social behavior of female vertebrates*. New York: Academic Press.
- Stack, C.B. (1974). *All our kin: Strategies for survival in a black community*. New York: Harper and Row.
- Trivers, R.L. (1974). Parent-offspring conflict. *American Zoologist*, 14, 249–265.
- van den Berghe, P. (1979). *Human family systems: An evolutionary view*. New York: Elsevier Science Publishing Co.
- Verner, J. (1964). Evolution of polygamy in the long-billed marsh wren. *Evolution*, 18, 252–261.
- Vining, D.R. (1986). Social versus reproductive success: The central theoretical problem of human sociobiology. *Behavioral and Brain Sciences*, 9, 167–216.
- Weatherhead, P.J., & Robertson, R.J. (1979). Offspring quality and the polygyny threshold: "The sexy son hypothesis." 113(2), 201–209.
- Weisner, T. (1987). Socialization for parenthood in sibling caretaking societies. In J. Lancaster, J. Altmann, A. Rossi, & L.R. Sherrod (Eds.), *Parenting across the lifespan: Biosocial dimensions*. New York: Aldine de Gruyter.
- Whiting, B. (1965). Sex identity conflict and physical violence: A comparative study. *American Anthropologist*, 67, 123–140.
- Whiting, J.W.M., & Whiting, B. (1975). Aloofness and intimacy of husbands and wives: A cross-cultural study. *Ethos*, 3, 183–207.
- Whiting, J.W.M., Burbank, V.K., & Ratner, M.S. (1986). The duration of maidenhood across cultures. In J.B. Lancaster & B.A. Hamburg (Eds.), *School-age pregnancy and parenthood: Biosocial dimensions*. New York: Aldine de Gruyter.
- Wrangham, R. (1980). An ecological model of female-bonded primate groups. *Behavior*, 75, 262–300.

Father Involvement, Reproductive Strategies, and the Sensitive Period

JENNY BLAIN and JEROME BARKOW

Introduction

After a long period of relative neglect, the role of the male in child-rearing is at last getting some attention in the social-behavioral and biological sciences (e.g., Mackey, 1985, 1986; Taub, 1984). One reason for this new interest is the powerful concept of parental investment of Robert L. Trivers (Trivers, 1972, 1985), which implies that under some circumstances males should invest substantially in their offspring.¹ Patricia Draper and Henry Harpending (1982) have recently applied the parental investment concept to human reproductive strategies. They hypothesize that the young child's experience of receiving (or not receiving) male parental investment in effect "sets" the reproductive strategy that individual will follow once he or she has reached puberty. Thus, for Draper and Harpending, early childhood is a sensitive period for reproductive strategies, and father's role in early child-rearing in part determines adolescent sexual behavior.

This novel approach has inspired the present chapter, which reviews the father-involvement literature and summarizes a preliminary test of the reproductive strategies hypotheses Draper and Harpending suggest.²

The Father's Role: A Problem of Definition

Family structure and the father's role within it vary widely both within and across societies, posing problems for disciplines seeking generalizations. In much of the sociological and psychological "family" literature

¹Trivers (1985; p. 457) defines parental investment as "anything done for the offspring . . . which increases the offspring's reproductive success at a cost to the remainder of the parent's reproductive success."

²Some of the data discussed below are taken from Blain's M.A. thesis (Blain, 1984). Barkow served as thesis supervisor.

a father's presence is assumed to constitute the "normal" state of affairs. Most attention has been focused on a single aspect of the father role, that of breadwinner, with little description of the actual interaction between father and child. Fein (1982; p. 464) points out that in the United States, "research concerning fathers has occurred within the context of social stereotypes and norms of American Society," and is only now beginning to focus on what men actually do and the extent to which they display nurturant behavior towards their children.

When the literature does consider other cultures, descriptions of father-child interactions are strangely lacking, particularly in older work. Even the "Six Cultures" study (Whiting, 1963), which represented an ambitious cross-cultural investigation of child-rearing practices, provided little data about the nature of father-child interaction. Brown (1981) and Blain (1984) discuss biases which may cause ethnographers to overlook children and child-related activities when describing a society (and particularly when describing the daily life of the men of that society): anthropologists have tended to consider male activities more important, and more noteworthy, than female activities, leading both to a dearth of information on the behavior of girls (in particular, Brown laments the lack of female life-cycle data) and to a lack of documentation on activities, such as child-rearing, seen as "female" by the anthropologist. This lack of data on father-child interaction in ethnographies may indicate that such interaction did not occur in the societies studied, but may also mean that the ethnographer was simply unaware of it, or else did not consider such interaction worth reporting.

Some more recent work does discuss the interactions of men and children (see for instance Briggs, 1970; Draper, 1975; Lee, 1979; Mitchell, 1978; Shostak, 1981). But it remains rare to encounter a study focusing specifically on father-child interaction, and children's dealings with other adult males (e.g., grandfathers) generally continue to go unreported (Mackey's [1985, 1986] work being the chief exception to this generalization).

Cross-Cultural Variation in Child-Rearing Roles

The ethnographic literature does yield some ideas about the range of variation in male and female child-rearing roles. Note, however, that the relevant data often are not directly available and must be inferred from descriptions of male and female residence patterns and daily activities.

Males play a fairly active part in child-rearing and nurturance among many foraging (gathering-hunting) peoples, whereas among some agricultural and horticultural groups men are likely to be physically separated from children. For example, among the Tasaday of Mindanao Island in the Philippines, sex differences in degree of responsibility for

child-rearing appear to be small (Nance, 1975), both sexes being involved in socialization and physical care as well as subsistence activities. Among the !Kung of the Kalahari desert, small children do spend more time with women than men, but males are expected to show affection and nurturant behavior towards young children (Lee, 1979). Briggs (1970), during her work in the Arctic, observed an Inuit father's interaction with his daughters and remarked on the tenderness and affection which he expressed toward them; the father was nurturant towards his children from the moment of their birth.

Of course, nurturant male roles are not restricted to hunter-gatherer peoples: in New Guinea, otherwise known for an extreme separation of the sexes (see below), Mitchell (1978) photographed men of the Wape going about their business as primary daytime caretakers of small children.

However, extreme separation of male and female roles is the norm among many horticultural (hoe-using) and agricultural (plow-using) peoples. For example, the separation of the domestic "women's world" from the public "men's world" has been well documented for Mediterranean and Middle Eastern agriculturalists (e.g., Fallers & Fallers, 1976; Reiter, 1975). Other forms of separation are found among horticulturalists. Thus, Murphy and Murphy (1974) describe the Amazonian Mundurucu as an extreme example of a "men's house" culture: men spend most of their time apart from their wives' houses, and generally do not even sleep there. In New Guinea, residential separation of the sexes is quite widespread (Langness, 1967; Strathern, 1972), an extreme example being that of the Enga: at the age of 5, boys are taught the local male belief in the pollutive nature of women, and shortly thereafter move from their mother's house to the men's house (Meggitt, 1964). Among East African (polygynous) horticulturalists, where the pattern of one hut per wife results in the separation of males and females, care of young children is seen as an almost totally female responsibility (LeVine & LeVine, 1966). But father-child separation is not so extreme among the West African Igbo, though even there it is the mother-child attachment which predominates throughout the individual's life (Njaka, 1974; Uchendu, 1968).

The cross-cultural variability of male and female parenting roles raises more questions than this chapter can answer. Why should the human species be capable of such flexibility in child-rearing roles? Is there a relationship between the particular roles practiced and climatic or subsistence patterns? How are children socialized into "appropriate" behavior patterns, and do socialization practices differ across cultures? Do similar "family" structures and similar degrees of father involvement in child-rearing have the same effects on children, given different environmental conditions? Can general theories of father involvement, its antecedents and consequences, be derived from the cross-cultural

data, or must we rely on particularistic theories, tailored to suit individual cultures? Reproductive strategies theory provides a ready starting point for seeking to answer such questions, but it is, after all, a relatively new perspective for the social/behavioral sciences. We will begin, therefore, by reviewing some nonsociobiological theoretical approaches to the role of father in the family, as a background against which sociobiological efforts may figure.

Father Involvement and Father Absence

STUDIES OF PATERNAL BEHAVIORS AND THEIR OUTCOMES FOR CHILDREN

Not only have there been relatively few studies of paternal behavior, many of those studies which have been carried out have focused not so much on the nature and extent of father's involvement with his children as on his absence. Writers and theorists often automatically seem to link (at least in Western society) low father-involvement ("father-absent") families with poverty, underprivilege, and deviant behavior. Recent criticisms of this approach, stemming largely from feminist, minority group and civil liberties movements, have pointed out that "the family" is not the same in all societies and that it may take many forms even in the West.

Lamb (1981, 1984) reviews psychological studies of paternal behavior and criticizes them on this last point (as well as on other grounds). These studies, Lamb charges, take a specific, stereotyped, and unexamined father role as a "given" and then go on to examine the effects of this assumed role on children by studying cases of "father absence" (i.e., cases where the father is not physically present in the household, generally following divorce). Researchers have linked father absence (particularly when it occurs in the early years of the child's life) to specific behaviors and attitudes of adolescents. For boys, these behaviors have included increased aggressivity and a "feminization" of cognitive style (e.g., Biller, 1971). Lamb cautions that "many of these studies have been focused on sex-role development, and most have adopted a very traditional definition of masculinity/femininity, deviations from which are negatively evaluated" (Lamb, 1981; p. 27).

Sociological and anthropological studies such as the "Moynihan Report" and the work of its critics (Ball, 1983; Hunt & Hunt, 1977), as well as the "Culture of Poverty" approach (Lewis, 1966) have also dealt with father absence. Both the "Moynihan Report" and the "Culture of Poverty" examined relationships between father absence (perceived as negative) and poverty and deviance (perceived as an outcome of father absence). While the two studies did differ considerably, both tended to

see father absence as dysfunctional and as linked to living styles of particular groups (e.g., poor urban U.S. blacks, poor Latin Americans). Critics of these studies have suggested that they overemphasized the negative effects of father absence and neglected positive effects (Hunt & Hunt, 1977), and that they encouraged "blaming the victim" (Leacock, 1971). Be that as it may, the studies maintained the pattern of studying paternal behavior and influence by examining "deviant" and low-status cases.

Note that both psychological and sociological/anthropological research on father involvement in the family has reflected another bias of our own culture: the work has tended strongly to focus on boys (Hunt & Hunt, 1977). Studies of the behavior of girls are plentiful neither in the ethnographic literature nor in Western psychological material (Draper & Harpending, 1982; O'Leary, 1984).

In an outstanding exception to this tendency to study males to the exclusion of females, Hetherington (1972) examined the behavior of adolescent girls from two-parent and mother-only U.S. families. The latter group were subdivided into daughters of divorcees and daughters of widows. Hetherington found behavioral differences among all three groups, particularly in interaction with males: it is the differences between the daughters of divorcees and the daughters of widows which are most relevant for present purposes.

Divorcee-daughters displayed interest in men, flirtatious behavior, sexual affiliativeness, and initiative in approaching the opposite sex, all to a greater degree than did the other groups. They tended to denigrate males and masculinity, and to describe their fathers as incompetent more frequently and strongly than did the other girls. These differences were greater when the separation of parents occurred in the first years of the daughter's life. Daughters of widows represented the other behavioral extreme: in the presence of males they became extremely reticent. On the occasion of a dance they were quite likely not to attend. Daughters of divorcees, on the other hand, were likely to ask the boys to dance, consistently taking the initiative. Finally, daughters from two-parent families would wait to be asked, in accordance with the then-prevailing local norm.

Though the cross-cultural literature on father involvement with children is sparse, it does at least suggest that, contrary to the usual orientation of North American and European father-involvement research, neither father absence nor its possible outcomes should automatically be viewed as adverse. The effects of father absence appear to depend in part on whether the absence is normative—culturally ordinary and usual—or nonnormative, that is, deviant. Thus, Whiting and Whiting (1975) found that the normative father absence common among polygynous peoples was associated with extreme competitiveness and

aggression among young males and hence the production of a warrior group. For the Whitings the association was functional rather than deviant, since (they believe) such warriors are needed for the protection of property.

The Whitings' findings are somewhat consistent with North American research results, which also link father absence and male aggression. The Whitings interpret their data in terms of their neo-Freudian "status-envy" hypothesis: for the Whitings, father absence results in boys having an early ("primary") identification with the mother, followed by later rejection of this identification (often by means of a puberty ritual) and development of a somewhat insecure ("secondary") masculine identity which is marked by exaggerated "protest masculinity" (D'Andrade, 1966). Since the Whitings' approach is an alternative to the Draper and Harpending "reproductive strategies" view, it will be examined in some detail later in this chapter. First, however, let us consider why father absence should be the norm in many human societies.

NORMATIVE FATHER ABSENCE: WHO BENEFITS?

Why should father absence, or at least low father involvement in child-rearing, be normative, in many societies? Some researchers, such as Blumberg (1976), suggest that where women are in fact supplying most of the subsistence labor, they may have more to lose than to gain by father involvement in child-rearing. In these societies, in which women are the main direct providers of food, it would not be in their interests single-handedly to provide for an unrelated male (the husband), especially if they can rely on consanguineal male kin to aid them in tasks such as ground-clearing. Moreover, many of these societies are polygynous (one husband with plural wives), and polygyny generally implies at least some degree of cooperation among co-wives in cultivation and child-care tasks (Bohannon, 1964; Clignet, 1970), and in some cases there is an explicit division of labor among co-wives (Clignet & Sween, 1981). In some societies, a series of short-term attachments to a succession of men may actually be more advantageous for a woman than a more enduring bond with a single partner. Thus, Brown (1975) concludes that among poor village women in the Dominican Republic, long-term bonding with one man would result in a drain on a woman's resources and ability to provide: short-term bonding proves a better economic strategy. Blumberg (1976; p. 14), looking to the U.S., concluded that "in those situations where economic uncertainty prevails but women have the possibility of achieving viable subsistence by their own labor, welfare payments, or the efforts of their children to whose earnings they have access, there is a high proportion of female heads of families."

Two Theories of Father Involvement

REPRODUCTIVE STRATEGIES AND THE SENSITIVE PERIOD

Draper and Harpending (1982) have pioneered an interpretation of the father-involvement literature which stems from evolutionary biology, and specifically from Robert Trivers' (1972) concept of "parental investment."³ Briefly, this approach considers that, in mammals, a considerable investment in offspring on the part of the mother (gestation, lactation), with no comparable paternal effort, is required. However, survival of offspring, depending on environmental constraints, may demand direct investment by individuals other than the mother. "Environmental constraints" here involve the relative abundance and scarcity of resources.

Suppose resources are scarce. Parental investment theory, as applied to our own species by Draper and Harpending, implies that males would now be more rather than less likely to provide parental investment, since without it their offspring might not survive at all. They would be especially likely to provide such investment for offspring of a female who in return provides some confidence in paternity. Males in a scarce resource environment should be prepared to form long-term bonds to such paternity-confidence providing females.

Again assuming resources to be scarce, male ontogenesis should stress developmental pathways involving resource accrual rather than verbal and interpersonal skills. This is because selection will favor their reproductive effort going into acquiring resources for parental investment, instead of the main effort going into sexual competition with other males. Females in the same resource-scarce environment should be prepared to form long-term bonds, and should tend to be highly selective with regard to sexual partners, for two evolutionary reasons: First, the females are most likely to be able to attract ready-to-invest males by providing paternity confidence, and a reputation for selectivity may inspire such confidence; second, since they are in a situation of scarce resources, selection will favor a female's postponing reproductive activities until she has some assurance of male parental investment, since otherwise her offspring might not survive.

In a situation of abundant resources, male investment in offspring is not crucial to their survival. Therefore, a male would maximize his fitness by maximizing mating effort rather than investment. "Maximizing mating effort" means maximizing mating opportunity by competing

³The term *father involvement* is preferable to *father absence* because the former connotes the possibility of degrees of involvement, whereas "absence" is a dichotomous concept.

with other males for access to females; in our species, such competition generally involves an emphasis on display and on verbal aggression and bombast, with the possibility of violence. Male ontogenesis in a resource-abundant environment should therefore emphasize developmental pathways related to these competitive skills. A female, in an environment of relatively abundant resources and (therefore) unreliable male parental investment, would maximize her fitness not through competitiveness but by commencing reproductive behavior as early as possible (to compensate for the lack of reliable male parental investment), by devoting her energies to feeding herself and her children (but not to providing for unrelated males), and by seeking male investment early in a relationship (since it could not be counted upon to be available later). Indeed, seeking early investment from a succession of males may be the only way in which she can regularly obtain any male parental investment at all. Referring back to the discussion of societies in which it is likely to be in a woman's economic interests to have a series of short-term partners rather than a single, long-term one, reproductive strategies theory would interpret this behavior as indicating that the women had, in early childhood, perceived resources to be abundant (regardless of what the actual state of affairs may have been.) (See Draper & Harpending, this vol., Chap. 12, for further discussion).

Human parenting and reproductive strategies are obviously highly variable. The problem Draper and Harpending (1982) set themselves was one of finding a single mechanism which in varying circumstances could produce varied but predictable results. The mechanism they propose is that of a "sensitive period." Rather than assuming some kind of rigid genetic control of human reproductive behavior (as some critics seem to imagine is an inevitable aspect of sociobiological analysis), Draper and Harpending suggest that the child's experiences during the first few years of life determine the strategy he or she will subsequently follow, a strategy presumably appropriate for local resource availability and which is "cued" to the child by the behaviors and attitudes of the men and women around him/her. Where men are "absent" from the child's world, the male strategy is communicated through cues given by women.

Draper and Harpending tentatively suggest that the first five years may be a sensitive period for the setting of reproductive strategies. Note, however, that although in the study described below we do evaluate the Draper and Harpending theory as they present it, this hypothesis of a sensitive period can theoretically be decoupled from their general approach. Reproductive strategies theory predicts only that courtship and pairing strategies will tend to track the environment in ways likely to enhance genetic fitness; the theory does not predict the mechanisms that should result in this behavior. Draper and Harpending hypothesize that a sensitive period is the mechanism that has evolved, and the

choice is a reasonable and plausible one; but alternative mechanisms may also have evolved.

For example, the high male-male competition and aggressivity Draper and Harpending explain as a result of low father involvement in family life during a sensitive period is accounted for by MacDonald (this vol., chap. 11) in terms of the negative affective tone of family life often associated with low father involvement. Moreover, Draper (in press) and Draper and Harpending (this vol., chap. 12) have recently emphasized perception of the availability of resources and extent of direct maternal investment required for child-rearing as important factors in reproductive strategies. But on the grounds that one should do one thing at a time, in this chapter we are concerned with evaluating Draper and Harpending's original proposal and in comparing it with a rival theoretical perspective on father involvement, the Whiting "status-envy" approach. Our goal is to compare the respective sets of hypotheses the two approaches yield.

STATUS-ENVY THEORY AND ITS ASSOCIATED PROBLEMS

John and Beatrice Whiting and their collaborators (listed in Whiting & Whiting, 1978) have investigated correlates of father absence in societies where this arrangement is normative. The Whitings' work has been far-reaching, indicating connections among low-protein diets, long post-partum sex taboos, polygyny, separate sleeping arrangements for spouses (and for father and young children), and high aggression levels among young males. They found that this cluster of characteristics tended to occur in conjunction with a particular lifestyle, one of sedentary horticulture in which women are responsible for a large part of the planting, weeding, and harvesting of the subsistence crop (Whiting & Whiting, 1975). The Whitings provide a complex causal chain of a theory, but here we are concerned with one link of it, that between father absence and aggression among young males.

The Whitings propose a neo-Freudian model of sex-role socialization based on status-envy and identification (D'Andrade, 1966, 1973; Spires & Robin, 1982; Whiting & Whiting, 1975), summarized as follows: In societies with fatherless households, the mother is perceived as controlling resources and exercising adult authority. A child, wishing to have these prerogatives, identifies with the mother, particularly if the father's absence occurs during the child's early years. Thus, early father absence leads to a feminine primary identity. Later, on leaving the mother's sphere of authority (as at initiation), boys find that other males have control of resources; they then learn to adopt a secondary "masculine" identity corresponding to culturally based ideas of masculinity: but they now have a conflict between their primary feminine and secondary masculine identifications. This hidden conflict may result in

"feminine" responses occurring in disguised form, such as a "feminized" cognitive style in which verbal skills are highly developed, and visuo-spatial skills are less developed. In such father-absent cultures, initiation ceremonies are likely to be necessary to permit the boy to overcome his primary "feminine" identity. The later-learned "masculine" identity may be stereotypically exaggerated, leading to compensatory or "protest" masculinity, which may take the form of high levels of aggressive behavior (D'Andrade, 1966).

For the Whitings and their collaborators, this model explains how the separation of husband and wife (and by extension of father and children) in daily living and sleeping arrangements may act as a mechanism to produce hyperaggressive young men. These young men, in the horticultural societies with which Whiting is concerned, act as a property-defending warrior group. Not only is father absence normative among these societies, but the end product, the warrior group, is "functional."

There are two serious problems with status-envy theory. First, the theory does not always work: that is, in some societies father absence does not appear to correlate with protest masculinity, or even necessarily with a "feminization" of cognitive abilities. For example, Parker, Smith, and Ginat (1975), in examining Mormon fundamentalist groups, found neither hyperaggression nor feminization to be the outcome of polygyny and its related father absence. They suggest that status-envy theory, in stressing the presence or absence of the father, neglects the active role of the mother. Montare and Boone (1980) repeat this accusation: on examining differences in aggressive behavior shown by U.S. black, Chicano, and white preadolescent boys in an inner-city environment, they found that father absence had seemingly different outcomes for the three groups. For explanation they turn to the differing styles of maternal behavior within the three cultures. McClelland (1981), after reviewing similar findings, suggests that a missing father may be important for producing aggressive behavior in patrifocal (male-centered) societies but not in matrifocal (or female-centered) ones.⁴ McClelland's findings are corroborated by Gonzalez (1984), who studied the social composition of the Garifuna of Guatemala, among whom a fluctuating household composition and movement of males out of the town coincide with a predominantly matrifocal ideology. (The question, of course, remains whether an ideology of male aggressivity is absent for this society.) Gonzalez reported that "detrimental effects of father absence have apparently been avoided" in this and other Caribbean societies. Carlsmith (1973), working with Harvard students, found that for his all-

⁴McClelland uses the word *matrifocal* in a sense similar to that of Tanner, who refers to societies where "the role of the mother is structurally, culturally and affectively central, and . . . this multidimensional centrality is legitimate" (Tanner, 1974; p. 131). *Matrifocal* is not here synonymous with father absence.

TABLE 13.1. Behavior of low father-involvement children and adolescents, as predicted by two theoretical approaches.

	Status-envy theory	Reproductive strategies
Boys	Initial feminization of behavior. Protest masculinity—competitive, aggressive, exhibitionistic—appearing later.	Competitive, aggressive, exhibitionistic behavior. No sudden break with earlier pattern—competitiveness prefigured in behavior of younger boys. Cues from women as to male parenting role important (cues given by mother, daycare center, etc.).
	Verbal skills stressed, visuo-spatial ability not stressed (feminization).	Verbal skills stressed, visuo-spatial ability not stressed (interpersonal skills).
Girls	No predictions.	Sexual affiliativeness, precocity or promiscuity appearing around puberty. Denigration of male abilities, and increased reliance on women. Cues from women as to appropriate strategy important (given by mother, daycare center, etc.).

male sample feminization of cognitive style was indeed linked to father absence, but there was no sign of “protest masculinity.”

The second major flaw in status-envy theory as developed by the Whitings is its lack of consideration of the behavior of girls and women. It focuses on the development of aggression among males and does not pretend to account for girls’ behavior (Biller, 1981; p. 321).⁵ The Whitings’ approach allows for no consideration either of the woman as an active participant in socialization or of the girl as recipient.

Predictions Drawn from the Reproductive Strategies and Status-Envy Approaches

The reproductive strategies and status-envy theories yield two distinct but somewhat overlapping sets of predictions. Table 13.1 compares these.

⁵Biller (1981; p. 321) adds, in parentheses after his comments on status-envy and masculine identification, that “a young girl will identify with her mother when she perceives her as the primary consumer of valued resources.”

For males, status-envy theory predicts that low father involvement should correlate with increased levels of physical and verbal aggressive behavior, bombast and rhetoric, and general "showing off." This behavior would be accompanied by a development of interpersonal skills (which the Whitings see as "feminine") rather than visuo-spatial abilities.

For low father-involvement males under some circumstances, the reproductive strategies approach would also predict these aggressive and exhibitionistic behaviors. However, where caretakers (usually but not always mothers) project the idea that the male role should be a "present" one, the male children would learn the strategy projected, picking up cues to the "appropriate" male role given by the mother or other caretaker rather than from the mere presence/absence of the father.

Only the reproductive strategies approach makes predictions for girls and women: low father-involvement females should tend to show early male-directed behavior (flirtation, affiliativeness) but be less likely than their father-present peers to show long-term bonding with one individual male, more likely to display a measure of promiscuity. They should be more likely to look to females rather than males for assistance with resource-related activities, and to derogate male abilities (particularly as providers).

Once again, however, the reproductive strategies approach suggests that the child would pick up cues to the appropriate strategy from the mother or other caretaker, so that where the mother appeared to behave as though the father were present (indicating that he would under normal circumstances be present), the daughter would learn a "father-present" strategy (possibly even in an exaggerated form). This approach thus accounts for the findings of Hetherington (1972) previously discussed: in the households of widows she studied, the father was in a sense "present"—perhaps, with his photograph on the table, he would be discussed and even idealized, and his abilities exaggerated over those of normally "present" fathers. In the case of households of divorcees the father was little discussed, and certainly not glorified.

Blain (1984) has applied this same line of reasoning to the possible effects of day-care center or nursery school attendance on the displayed behaviors. What may be true of mothers providing cues to children about appropriate expectations from fathers may also be true of day-care attendants. Thus, Blain predicted that children attending a day-care center should tend to reduce aggressive and/or sexually affiliative behavior, in line with reproductive strategies/sensitive period theory. Her assumption here is that most formal day-care centers tend to project a "family" ideology, in the sense that parents (of both sexes) are talked about and books are looked at showing families. In addition, even low father-involvement children see parents of both sexes drop off children and collect them, so that they are exposed to high male involvement in

child-related activities. If Draper and Harpending are correct in their hypothesis that reproductive strategies "set" in part from cues given by caretakers about normative male behavior rather than from the actual physical presence of the males, then day-care attendance should be expected to have some effect on behavior.

In the study discussed below, an attempt was made to undertake a preliminary test of these predictions in the context of a small-scale research project.

REPRODUCTIVE STRATEGIES AND THE AGE OF MENARCHE

There was one set of predictions stemming from reproductive strategies theory not tested here but for which some data exist. These predictions (made in Barkow, 1984) involve not behavior but physical growth and development, and they are not made by status-envy theory. The predictions are as follows: If low father-involvement males follow a pathway of competition, including physical competition, then they should tend to develop more muscular physiques than do high father-involvement boys. If low father-involvement girls follow a pathway including earlier sexual activity, they should reach menarche prior to high father-involvement girls. While no data are available concerning the muscularity of boys, there are some data on age of menarche of girls.

M. Surbey (1986, personal communication) found, in a survey of 722 Southern Ontario university students, a "significant positive correlation . . . between the age of menarche and the number of years of exposure to a father figure. Girls whose fathers were absent from the home for a period of time before their 15th birthday reached the menarche 5–6 months earlier than girls whose fathers resided with them continuously." Surbey's analysis was not yet complete at the time of this writing, but similar results were obtained by Jones, Leeton, McLeod, and Wood (1972) in a survey conducted in Melbourne, Australia. However, a reproductive strategies interpretation of their (and Surbey's) findings is not the only one possible: obesity may be an alternative explanation.

We know (Frisch & McArthur, 1974) that age at menarche is linked to proportion of body fat. Could it be that in some way, early father absence leads to obesity? Perhaps there is some compensatory overeating, or perhaps obesity is more common among lower socioeconomic groups, and father absence either itself lowers the family's economic status or is more common among lower socioeconomic groups. Unfortunately, Jones et al. did not attempt to control for socioeconomic variables, nutritional status, etc.⁶ But at least it is clear what type of research is needed to

⁶Nor, for that matter, do they offer any explanation for the apparent link between early menarche and father absence.

distinguish between reproductive strategies versus obesity explanations for the tie between low early father involvement and age at menarche: if the obesity hypothesis is accurate, then overweight should be a better predictor of age at menarche than early low father involvement *per se*; while if degree of obesity is controlled then the relationship between early low father involvement and age at menarche should disappear. If the reproductive strategies interpretation is accurate, then controlling for obesity should have no effect on the relationship between early father absence and age at menarche, regardless of whether the obesity in question is early obesity or that occurring at the onset of menses. Until these hypotheses have been tested, all that proponents of reproductive strategies theory can fairly claim is that the findings of Surbey and of Jones et al. are encouraging but not conclusive.

A Preliminary Test of Hypotheses on a Clinical Population of Children and Adolescents

DESIGN OF THE STUDY, AND SPECIFIC HYPOTHESES

There are several ways in which status-envy and reproductive strategies hypotheses could be tested, ranging from holocultural (cross-cultural) surveys, such as those utilized by the Whiting school, to intensive ethnographic analysis of single societies, to observation of actual behavior in a social setting of low and high father-involvement adolescents. The ideal method would probably be the longitudinal study. However, since resources were limited and the study intended in any case to be preliminary, Blain (1984) used as subjects the clients of a child guidance center. Data regarding degree of father involvement in child-rearing were necessarily retrospective and were gathered during interviews with the parent or parents.

This preliminary study required a number of compromises. Thus, use of clinical data precludes the results being generalized to a nonclinical population. Moreover, all data had to be collected by the center staff rather than by Blain or by a trained research assistant. Staff agreed to include a brief questionnaire as part of a regularly scheduled interview. This questionnaire dealt with family history of those clients who were currently living with at least one of their biological parents and who were accompanied to the center by a parent who could give the necessary information. The questionnaire included questions about the client's behavior, including the reasons for his or her referral to the center. In all, data on 99 children (50 girls and 49 boys) were collected. At the time of the interview 55% of the boys and 44% of the girls were living in mother-only households. Detailed accounts of data collection and analysis are given in Blain (1984).

The method of data collection permitted gathering of retrospective information on family composition during the first 5 years of the child's life. However, it was necessary to restrict the analysis to whether the father was physically present or absent in the household, since questions about the father's participation in child-rearing activities proved difficult to ask during the very limited time available for the interviews. Information on the child's attendance at a day-care center or nursery school and on other nonparental caretaking arrangements was obtained, along with the details of the present household composition and of the educational and occupational status of the parents and other custodial adults.

Direct assessment of the children's behavior was not feasible, given the constraints on the study, but two surrogate measures of behavior were available: first, the reasons for which the child was purportedly referred to the agency (see Table 13.2) and second, whether or not the agency had received reports of the child showing aggressive, exhibitionistic, sexually precocious, or truanting behavior (Table 13.3). Of the five possible reasons for referral (or presenting problems) listed on the center's admission forms, the category most pertinent to our purposes was that of "socially disruptive behavior." Finally, in recording reports of aggressive or exhibitionistic behavior, the agency was asked to indicate whether these referred to verbal behavior, physical behavior, or both.

The data collected were used to test predictions concerning a correlation between absence of the father during all or part of the first 5 years of the child's life and (1) later aggressive or exhibitionistic behavior of boys or (2) later sexually affiliative, precocious or promiscuous behavior of girls, and (3) the possible mitigating effect of day-care attendance on these correlations. Given the very indirect nature of the behavioral data available, and given that many of the girls in the study were too young

TABLE 13.2. Presenting problem for children and adolescents referred to the guidance center.

Presenting problem	Boys (<i>N</i> =49)		Girls (<i>N</i> =50)	
	Number of cases	% of total	Number of cases	% of total
Socially disruptive behavior	22	44.9	15	30.0
Disoriented/bizarre behavior	1	2.0	0	0
Emotional nonsocial behavior	6	12.2	16	32.0
Family maladjustment	21	42.9	26	52.0
Developmental disorder	4	8.2	2	4.0
Other	5	10.2	4	8.0

Note: Percentages sum to more than 100 as more than one response might be recorded for each individual.

TABLE 13.3. Reports of aggressive or exhibitionistic behavior, sexual precocity or truancy.

Behavior reported	Boys (N=49)		Girls (N=50)	
	Number of cases	% of total	Number of cases	% of total
Aggressive				
Physical only	5	10.2	3	6.0
Verbal only	7	14.3	9	18.0
Both	10	20.4	4	8.0
Exhibitionistic				
Physical only	2	4.1	2	4.0
Verbal only	—	—	2	4.0
Both	5	10.2	5	10.0
Sexual precocity	2	4.1	3	6.0
Truancy	6	12.2	3	6.0

Note: More than one behavior might be recorded for each individual.

for their behavior to be reported as “sexually precocious or promiscuous,” the feasible hypotheses can be restated as follows:

1. A stronger-than-chance relationship was predicted, in the case of boys, between absence of the father from the household during all or part of the first 5 years and the later displaying of inappropriate physical or verbal aggressive or exhibitionist behavior, as indicated by receipt of reports of this behavior or of sexual promiscuity or truancy, or by referral to the agency for social disruptive behavior (predicted by both reproductive strategies and status-envy approaches).
2. A stronger-than-chance relationship was predicted, in the case of girls, between absence of the father from the household during all or part of the first 5 years and the later displaying of inappropriate sexually affiliative or precocious behavior or its possible precursors, as indicated by reports of these behaviors or of other “physical” behavior such as physical exhibitionism or aggression, or truancy (predicted by reproductive strategies approach only).
3. Day-care attendance during the 5-year period would be expected to have a mitigating effect on the expected behaviors, for father-absent boys and girls (predicted by reproductive strategies approach only).⁷

RESULTS OF THE STUDY

A selection of results obtained from data for boys and for girls is given in Tables 13.4 and 13.5, and a summary of the extent to which these

⁷The 99 children participating in the study included only 4 who had a widowed parent, so that differences in behavior between children of widows and of other single mothers could not be tested.

TABLE 13.4. Results for boys: Results relating presence of physical or verbal aggressive/exhibitionistic behavior, as noted by center staff, to various measures of father absence in the first 5 years of boy's life (day-care attendance also shown), $N=49$.

Independent variable	<i>T</i> -value	Zero-order	Partial correlation ^a	Partial correlation ^b
Father ever had period of absence (dichotomous measure)	1.90 ($p=.06$)	.267 ($p=.03$)	.337 ($p=.01$)	.331 ($p=.01$)
Number of 6-month periods in which father absent (cumulative measure)	1.50 ($p=.14$)	-2.72 ^c ($p=.03$)	-.345 ^c ($p<.01$)	-.337 ^c ($p=.01$)
Number of 6-month periods in which boy attended day-care center or nursery school	0.03	-1.24		

^a Controlling for attendance at a day-care center or nursery school, 45 df.

^b Controlling for current presence of a male guardian in household, mother's education, child's age, and attendance at day-care center or nursery school during first 5 years, 42 df.

^c Cumulative measure modified by use of negative exponential transformation on data. The negative sign is thus expected.

hypotheses were supported is given in Table 13.6. It can be seen that some support was found for the hypotheses, in that absence of the father does appear to correlate, though not strongly, with the predicted behaviors. Controlling for day-care or nursery school attendance strengthens the correlations: controlling for social variables, for boys, has little apparent effect; for girls, correlations are strengthened. These results are found when the "absence" variable is dichotomous (absence/presence) and also when an attempt is made to indicate the

TABLE 13.5. Results for girls: Results relating presence of physical or verbal aggressive/exhibitionistic behavior, as noted by center staff, to various measures of father absence in the first 5 years of girl's life (day-care attendance also shown), $N=50$.

Independent variable	<i>T</i> -value	Zero-order	Partial correlation ^a	Partial correlation ^b
Father ever had period of absence (dichotomous measure)	1.34 ($p=.19$)	.042	.231 ($p=.06$)	.295 ($p=.03$)
Number of 6-month periods in which father absent (cumulative measure)	-.21	-.105 ^c	-.132 ^c	-.205 ^c ($p=.09$)
Number of 6-month periods in which girl attended day-care center or nursery school	-.88	-.163 ($p=.13$)		

^a Controlling for attendance at a day-care center or nursery school, 46 df.

^b Controlling for parent's occupation, mother's education, child's age, and attendance at day-care center or nursery school during first 5 years, 43 df.

^c Cumulative measure transformed by use of negative exponential transformation on data. The negative sign is thus expected.

TABLE 13.6. Extent to which hypotheses relating aggressive/exhibitionistic behavior to father absence were supported by data (Blain, 1984).

Hypothesis	Supported?
Boys	Zero-order
Relationship between father absence and aggressive/exhibitionistic behavior.	Yes, weakly. When controls used Yes, supported more strongly. This indicates need to control for social factors and, importantly, day-care center attendance.
Girls	Zero-order
Relationship between father absence and aggressive/exhibitionistic behavior.	Very weak correlations do exist, but could not be relied on if no other evidence existed. Strong relationship with CURRENT presence of father or male guardian. When controls used Supported more strongly as long as current presence of male guardian is not also controlled for. Important to control for day-care center attendance, and social variables.
Girls and boys	Combined effects
Possible mitigating effect of cues from day-care center, etc, during early period.	Effect of day-care clearly shown for both boys and girls. Essential to control for this when estimating effect of father absence, especially for girls where correlations did not appear significant until day-care center attendance was controlled.

length of time for which the father was absent, provided a negative exponential transformation is used on the data. (This transformation reflects Blain's belief that a difference between no periods of absence and one period would be much more important for the child than a difference between eight periods and nine periods.)

This study was intended only as preliminary work and its results are suggestive rather than definitive. The hypotheses do not completely distinguish between the two theoretical approaches discussed, since the relationship between low father involvement and high male adolescent aggressive behavior is predicted by both approaches. The importance of controlling for attendance at day-care centers or nursery school, while agreeing with the reproductive strategies hypotheses, could be explained in other ways (e.g., deliberate training for nonaggression at such centers, or perhaps even the reduced exposure of center children to aggressive or violent images, compared with children at home). However, this is, to the knowledge of the authors, the first study specifically designed to test the reproductive strategies approach, and the results are such as to make further work along these lines appear very attractive. Further work should include the refining of the concept of the

sensitive period. The idea of the “first few years” is obviously imprecise, and the ways in which cues are picked up by the child are as yet unknown. The methodology should also include some naturalistic observation of the social behavior of young people, perhaps along the lines of Hetherington (1972), who observed at a dance.

A HOLOCULTURAL APPROACH

For those considering possible research on reproductive strategies theory and father involvement, a holocultural (cross-cultural survey) study, similar in methodology to those of the Whittings (e.g., Whiting & Whiting, 1975, 1978), would provide a complementary approach. We ourselves have carried out a few (unpublished) preliminary investigations using data available through the *World Cultures Electronic Journal*. This data bank includes variables coded from a large number of studies all of which have used the Standard Cross-Cultural Sample (Murdock & White, 1969).

We were particularly interested in Barry and Paxson's (1985) codes on infancy and childhood, and in correlations of these with other variables relating to male aggression and male attitudes to women, and to female sexual expression and attitudes to men, constructed by a number of workers in this field (in particular Sanday, 1985, and Whyte, 1985).

Table 13.7 gives the most promising correlations obtained from this preliminary analysis. These results lend strength to the association of low father involvement with increased male aggressivity. When we used Whyte's (1985) index of the emphasis placed by a society on valuing male aggression, strength, and sexual potency, we found this to be related to the father's role during both infancy and early childhood, distant fathers being associated with a high emphasis on these traits. When, however, we used Sanday's (1985) variable relating to the presence or absence of an ideology of male toughness, we found this clearly associated with the role of the father in infancy, but not in early childhood.

Unfortunately, the World Cultures data bank does not appear to contain variables suitable for testing reproductive strategies predictions about female behavior: new indicators, specifically designed for the purpose, need to be created and rated for the Standard Sample.⁸

⁸New indicators should include indices for both the dependent variables of male aggressivity and female sexual expression, and the independent variables of father involvement and mother's attitude to men. Work in this area could then reexamine the Whiting's approach, and by subjecting both their status-envy theory and Draper and Harpending's reproductive strategies approach to similar testing would greatly aid discrimination between the two approaches.

TABLE 13.7. Preliminary results from tests using holocultural data and methods: Correlations of variables relating to male aggressivity with Barry and Paxson's (1985) indices of the role of the father in infancy and in early childhood.^a

Independent variable	Role of father			
	In infancy		In early childhood	
	<i>N</i> ^b	<i>r</i> ^c	<i>N</i> ^b	<i>r</i> ^c
"Ideology of male toughness" (Sanday, 1985). (0= ideology absent in society 1=ideology present)	93	-.36 (<i>p</i> < .001)	89	-.23 (<i>p</i> < .05)
"Ideology of male toughness" combined with "moderate or frequent interpersonal violence." From Sanday's (1985) data on toughness combined with her variable on interpersonal violence (0=both absent 1=either toughness ideology or violence present 2=both present)	85	-.34 (<i>p</i> < .01)	78	-.09 (n.s.)
"High value placed on males being aggressive, strong, and sexually potent" (Whyte, 1985). (1=marked emphasis on this in the society 2=moderate emphasis 3=little or no emphasis)	69	.33 (<i>p</i> < .01)	72	.34 (<i>p</i> < .01)

^aIndices recoded so that 1=father distant or rarely close, 2=father occasionally close, 3=father frequently or regularly close.

^b*N* = number of societies on which data are available on both dependent and independent variables in the "World Cultures" file (out of a possible 186).

^c*r* = Pearson's correlation coefficient.

Conclusions

The father-involvement literature is weak both cross-culturally and even with regard to data from Western society. The scant attention paid to girls is an obvious omission, and the conceptualization of father involvement in terms of "present" or "absent" is so gross a simplification that questions of just what it is that father does and how he is perceived are begged. Status-envy theory is at first glance impressive, given the string of holocultural studies that have utilized it. At second glance, however, it becomes clear that it tells us little about females and yields predictions that are not consistently verified by empirical research. Reproductive strategies theory, stemming as it does from parental investment theory—a powerful development in evolutionary biology which has thus far proven applicable to every animal species for which we have appropriate data—holds much promise but remains too new

and too unexamined to be, as yet, widely accepted in the social-behavioral sciences.

This chapter's discussion of the low father-involvement literature has illustrated the usefulness of the reproductive strategies approach for students of the family and of child socialization and development. For example, it succeeded in ordering apparently contradictory data (i.e., the diverse findings relating to the relationship between father absence and male aggression) while focusing attention on the neglected topic of cues from the mother. Reproductive strategy has such obvious links with reproductive success that it is implausible that natural selection would have failed to produce complex mechanisms that in some way track external conditions so as to optimize fitness. Regardless of whether Draper and Harpending are right in detail, they are certainly asking the right questions, and doing so in a manner which generates testable hypotheses.

Simple ideas of global learning abilities are slowly giving way in psychology, being replaced by, for example, the complex perceptual modules of Fodor (1983), the "language acquisition device" of Chomsky (1980), or the "algorithms" of Cosmides and Tooby (in press) and Tooby and Cosmides (in press). Past theories of child socialization and culture "transmission" have tended to be unrelated to evolutionary perspectives and tied either to a psychology little more complex than that of "global learning" or, like the Whiting school, to neo-Freudian reasoning. Draper and Harpending, who appreciate that understanding phylogenetic adaptation requires theories of ontogenetic adaptation, provide a psychological theory sufficiently complex to at least begin to account for culture transmission and variation in the area of courtship/reproductive strategies. Though sociobiological, their hypotheses emphasize the importance of the environment and are very far from the stereotypical rigid genetic determinism quite wrongly associated with the application of evolutionary biology to human behavior. The power of their approach is indicated by the fact that it leads to hypotheses not just about behavior but about physical growth and development, hypotheses for which at least some support has been forthcoming. This chapter represents only the beginning of research on the Draper and Harpending hypotheses (though even the very preliminary results are heartening). Draper and Harpending, in turn, represent only the beginning of the application of sociobiology to questions of ontogeny and of social transmission of family culture.⁹

⁹For example, Rutter and Madge's (1976) important study of the social transmission of family pathology, *Cycles of Disadvantage*, merits reinterpretation in terms of the phylogenetic-adaptation-requires-ontogenetic-adaptation framework of Draper and Harpending. So, too, does Rohner's (1975) cross-cultural study of child rejection.

REFERENCES

- Ball, R.E. (1983). Family and friends: A supportive network for low income American black families. *Journal of Comparative Family Studies*, 14, 51–65.
- Barkow, J.H. (1984). The distance between genes and culture. *Journal of Anthropological Research*, 37, 367–379.
- Barry, H., III, & Paxson, L.M. (1985). Infancy and early childhood. *World cultures electronic journal*, 1. (Codes reprinted from *Ethnology*, 10, 466–508, 1971).
- Biller, H.B. (1971). The mother-child relationship and the father-absent boy's personality development. *Merill-Palmer Quarterly of Behavior and Development*, 17, 227–241.
- Biller, H.B. (1981). The father and sex role development. In M.E. Lamb (Ed.), *The role of the father in child development* (2nd ed.). New York: Plenum Press.
- Blain, J.M.M. (1984). *Family structure and reproductive strategies: An application of the sensitive period approach to a clinical population of children and adolescents*. Unpublished master's thesis. Dept. of Sociology and Social Anthropology, Dalhousie University, Halifax, N.S.
- Blumberg, R.L. (1976). Fairy tales and facts: Economy, family, fertility and the female. In I. Tinker & M.B. Bramsen (Eds.), *Women and world development*, Washington, DC: Overseas Development Council.
- Bohannan, L. [E. Smith Bowen] (1964). *Return to laughter*. New York: Doubleday.
- Briggs, J. I. (1970). *Never in anger*. Cambridge, MA: Harvard University Press.
- Brown, J. (1981). Cross-cultural perspectives on the female life-cycle. In R.L. Munroe, R.H. Munroe, & B.B. Whiting (Eds.), *Handbook of cross-cultural human development*. New York and London: Garland STPM Press.
- Brown, S.E. (1975). Love unites them and hunger separates them: Poor women in the Dominican Republic. In R.R. Reiter (Ed.), *Toward an anthropology of women*. New York and London: Monthly Review Press.
- Carlsmith, L. (1973). Some personality characteristics of boys separated from their fathers during World War II. *Ethos*, 1(4), 466–477.
- Chomsky, N. (1980). *Rules and representations*. New York: Columbia University Press.
- Clignet, R. (1970). *Many wives, many powers*. Evanston: Northwestern University Press.
- Clignet, R., & Sween, J.A. (1981). For a revisionist theory of human polygyny. *Signs*, 6, 445–468.
- Cosmides, L., & Tooby, J. (in press). Evolutionary psychology and the generation of culture, II. Case study: A computational theory of social exchange. *Ethology and Sociobiology*.
- D'Andrade, R.G. (1966). Sex differences and cultural institutions. In E. Maccoby (Ed.), *The development of sex differences*. Stanford, CA: Stanford University Press.
- D'Andrade, R.G. (1973). Father-absence, identification, and identity. *Ethos*, 1(4), 440–455.
- Draper, P. (1975). Cultural pressure on sex differences. *American Ethnologist*, 2, 602–616.
- Draper, P. (in press). African marriage systems: The perspective from evolutionary ecology. *Ethology and Sociobiology*.

- Draper, P., & Harpending, H. (1982). Father absence and reproductive strategy: An evolutionary perspective. *Journal of Anthropological Research*, 38, 225-273.
- Fallers, L.A., & Fallers, M.C. (1976). Sex roles in Edremit. In J.G. Peristiany (Ed.), *Mediterranean family structures*. Cambridge: Cambridge University Press.
- Fein, R.A. (1982). Research on fathering: Social policy and an emergent perspective. In A.S. Skolnick & J.H. Skolnick (Eds.), *Family in transition*. Boston and Toronto: Little, Brown and Company.
- Fodor, J.A. (1983). *The modularity of mind*. Cambridge, MA: MIT Press.
- Frisch, R.E., & McArthur, J.W. (1974). Menstrual cycles: Fatness as a determinant of minimum weight for height necessary for their maintenance or onset. *Science*, 185, 949-951.
- Gonzalez, N.L. (1984). Rethinking the consanguineal household and matrifocality. *Ethnology*, 23, 1-12.
- Hetherington, E.M. (1972). Effects of father absence on personality development in adolescent daughters. *Developmental Psychology*, 7, 313-326.
- Hunt, J.G., & Hunt, L.L. (1977). Race, daughters and father loss: Does absence make the girl grow stronger? *Social Problems*, 25, 89-102.
- Jones, B., Leeton, J., McLeod, I., & Wood, C. (1972). Factors influencing the age of menarche in a lower socioeconomic group in Melbourne. *Medical Journal of Australia*, 2, 533-535.
- Lamb, M.E. (1981). Fathers and child development: An integrative review. In M.E. Lamb (Ed.) *The role of the father in child development* (2nd ed.). New York: Plenum Press.
- Lamb, M.E. (1984). Observational studies of father-child relationships in humans. In D.M. Taub (Ed.), *Primate paternalism*. New York: Van Nostrand Reinhold.
- Langness, L.L. (1967). Sexual antagonism in the New Guinea highlands: A Bena-Bena example. *Oceania*, 37, 161-177.
- Leacock, E.B. (Ed.). (1971). *The culture of poverty: A critique*. New York: Simon and Schuster.
- Lee, R.B. (1979). *The !Kung san*. Cambridge: Cambridge University Press.
- LeVine, R.A. & LeVine, B.B. (1966). *Nyansongo: A Gusii community in Kenya*. New York and London: John Wiley.
- Lewis, O. (1966). The culture of poverty. *Scientific American*, 215, 21-29.
- Mackey, W. (1985). *Fathering behaviors: The dynamics of the man-child bond*. New York: Plenum Press.
- Mackey, W. (1986). A facet of the man-child bond: The teeter-totter effect. *Ethology and Sociobiology*, 7, 117-134.
- McClelland, D.C. (1981). Child-rearing versus ideology and social structure as factors in personality development. In R.L. Munroe, R.H. Munroe, & B.B. Whiting (Eds.), *Handbook of cross-cultural human development*. New York and London: Garland STPM Press.
- Meggitt, M.J., (1964). Male-female relationships in the highlands of Australian New Guinea. *American Anthropologist*, 66, 204-224.
- Mitchell, W.E. (1978). *The bamboo fire*, New York: W.W. Norton.
- Montare, A., & Boone, S.L. (1980). Aggression and paternal absence: Racial-ethnic differences among inner-city boys. *Journal of Genetic Psychology*, 137, 223-232.

- Murdock, G.P., & White, D.R. (1969). The standard cross-cultural sample. *Ethnology*, 8, 329-369.
- Murphy, Y., & Murphy, R. (1974). *Women of the forest*. New York: Colombia University Press.
- Nance, J. (1975). *The gentle Tasaday*. New York: Harcourt Brace Jovanovitch.
- Njaka, M.E.N. (1974). *Igbo political culture*. Evanston: Northwestern University Press.
- O'Leary, K.D. (1984). Marital discord and children: Problems, strategies, methodologies, and results. In A. Doyle, D. Gold & D.S. Moskowitz (Eds.), *Children in families under stress. New Directions in Child Development*, 24, 35-46.
- Parker, S., Smith, J. & Ginat, J. (1975). Father absence and cross-sex identity: The puberty rites controversy revisited. *American Ethnologist*, 2, 287-706.
- Reiter, R.R., (1975). Men and women in the south of France: Public and private domains. In R.R. Reiter (Ed.). *Toward an anthropology of women*. New York: Monthly Review Press.
- Rohner, R.P. (1975). *They love me, they love me not*. New Haven: HRAF Press.
- Rutter, M., & Madge N. (1976). *Cycles of disadvantage*. London: Heinemann Educational Books Ltd.
- Sanday, P.R. (1985). Female power and male dominance. *World cultures electronic journal*, 3. (Codes previously unpublished.)
- Spires R.C., & Robin, M.W. (1982). Father absence cross-culturally: A review of the literature. In L.L. Adler (Ed.), *Cross-cultural research at issue*. New York: Academic Press.
- Shostak, M. (1981). *Nisa, the life and words of a !Kung woman*. Cambridge, MA: Harvard University Press.
- Strathern, M. (1972). *Women in between*. New York: Seminar Press.
- Tanner, N. (1974). Matrifocality in Indonesia and Africa and among black Americans. In M.Z. Rosaldo & L. Lamphere (Eds.), *Women, culture and society*. Stanford, CA: Stanford University Press.
- Taub, D.M. (Ed.). (1984). *Primate paternalism*. New York: Van Nostrand Reinhold.
- Tooby, J., & Cosmides, L. (in press). Evolutionary psychology and the generation of culture, I. Theoretical considerations. *Ethology and Sociobiology*.
- Trivers, R.L. (1972). Parental investment and sexual selection. In B. Campbell (Ed.), *The descent of man*. Chicago: Aldine.
- Trivers, R.L. (1985). *Social evolution*. Menlo Park, CA: Benjamin/Cummings.
- Uchendu, V.C. (1968). *The Igbo of southeast Nigeria*. New York: Holt, Rinehart and Winston.
- Whiting, B.B. (Ed.). (1963). *Six cultures: Studies of child rearing*. New York and London: John Wiley.
- Whiting, J. & Whiting, B.B. (1975). Aloofness and intimacy of husbands and wives: A cross-cultural study. *Ethos*, 3, 183-207.
- Whiting, J., & Whiting, B.B. (1978). A strategy for psychocultural research. In G. Spindler (Ed.), *The making of psychological anthropology*. Berkeley and Los Angeles: University of California Press.
- Whyte, M.K. (1985). Cross-cultural codes dealing with the relative status of women. *World cultures electronic journal*, 3. (Codes reprinted from *Ethnology*, 17:211-237, 1978).

Index

A

Adaptability, 82, 88, 192; *see also*

Plasticity

Adaptation, 20, 253, 271, 320, 321,
330, 334, 393

and adoption, 282–283

and affect, 322, 323, 324, 330

and altruism, 140–141, 162,

331–332

and attractiveness, 224

and behavioral genetics, 16

and beliefs, 126–133, 306

and child maltreatment, 303–304,
311–313

and cognitive-developmental
theory, 15

and cross-cultural research, 17–18

and deception, 104, 106

and parenting, 212, 213–221, 273,
274–275, 298

and ethological theory, 11–12

and learning, 342–345

and life history theory, 79, 81, 85,
87–88

and malnutrition, 303–304

and maturation, 207, 208, 209,
210, 217–218

and plasticity, 9, 89, 208–209, 286,
303, 348

and pragmatism, 124–126

and psychiatric disorder, 7–8,
362–366

relation to resources, 25, 26, 28–32,

33, 34, 35, 42, 44, 52, 53, 56, 58,
64, 65, 68, 70, 71

and same-sex bonding, 215–216

and self-deception, 103, 106, 225

and self-knowledge, 103–104, 123

and social learning theory, 13–14

and sociobiological theory, 5–11,
296, 298

and valid knowledge, 120–124

Adaptationism, *see* Adaptation

Adolescence, 19, 207–228, 326, 328,
355, 373, 376, 377; *see also*

Puberty

Affect, 6, 12, 13–14, 15, 18, 213, 227,
240, 258, 261

and altruism, 162, 278

and family relationships, 276–278,
279–280, 304, 310–311, 321–332,

335, 336, 348–350, 375, 381

and genetic relatedness, 180,
185–197, 288

and moral reasoning, 154, 159,
160–161

Aggression, 8, 161, 334

and adolescence, 207, 214, 216,
225

and father absence, 352, 353, 376,
378, 381–393

genetic variation for, 16, 331–332

as resource-directed behavior, 27,

39, 40, 41, 45, 47, 49, 50, 68, 301

socialization of, 85–86, 329, 332

within families, 293–314

Aggression (*cont.*)*see also* Child abuse

Altruism, 11, 18, 19, 143–144, 156, 160, 196, 212, 235, 342
 and evolutionary theory, 43–44, 45, 141, 159, 174–175, 296
 genetic influences, 10, 16, 169, 173, 177–182, 198, 199
 socialization, 162, 278, 332, 346, 347

Anthropology, 4, 6, 33, 78, 79, 246, 260, 261, 376; *see also* Cross-cultural research

Assortative mating, 8, 192

Attachment, 6, 11–12, 26, 93, 280, 321–322, 323, 332, 378

Attributions

and manipulation of others, 15
 and self-deception, 115–118, 119, 126–133, 155–157
 and valid knowledge, 123

B

Behavioral genetics, 5, 10–11, 16, 19, 69–70, 168–199, 241–242, 331

Buffering of phenotype, 14, 82, 89, 158; *see also* Canalization

C

Canalization

and maturation, 218–219
 and plasticity, 89–96
 relation to individual differences, 241–242
see also Buffering of phenotype

Central tendencies, 5, 8, 10, 11,

14–15, 17, 18, 324–325; *see also* Buffering of phenotype, Canalization, Universals

Cheating, 49, 342, 365–366

Child abuse, 18, 192, 211, 214, 272–276, 293–314, 335

Coefficient of genetic relatedness, 3, 174–175; *see also* Genetic relatedness

Cognition, 7, 12, 15, 93, 94, 157–158, 163, 227, 234–261, 288, 310, 353
 and deception, 105

and dominance, 220

and language acquisition, 253–254

and moral development, 140–163

and musical understanding, 254–256

and reproductive strategy, 359–362, 382

and resource acquisition, 38, 60

and the self-system, 103–133

see also Cognitive-developmental theory, Information processing, Memory, Perception

Cognitive-developmental theory, 5, 14–15, 157, 163, 240; *see also* Cognition

Competition, 10, 16, 66, 90, 146, 214, 225, 226–227, 295, 378, 385

and cooperation, 44–50

and dominance, 46, 217

and father absence, 347, 353, 359

genetic influences, 168, 172–174, 177–182, 197, 198, 199

socialization of, 54–55

see also Sexual competition,

Resource competition

Conditioning, *see* Learning

Conflict of interest, 15, 17, 18, 49, 194, 320; *see also* Parent-offspring conflict

Contextual variable(s), 10, 12, 13, 15, 16, 18, 71

and family interactions, 324–330, 335, 336, 341–342, 347–362

and fitness, 321, 329

and moral reasoning, 145–148, 154–155, 158, 160

see also Contextualism

Contextualism, 16–17; *see also* Contextual variable(s)

Continuity

of behavior, 19–20, 96

of dominance, 218–220

of environment, 91, 96

Cooperation, 10, 16, 40, 45, 342

and competition, 25, 27, 39, 44–50, 66

genetic influences, 168, 172–174, 177–182, 197, 198, 199

socialization of, 54–55

see also Helping, Sharing

Costs and benefits, 194, 225
 and life history theory, 82, 84–85, 86, 91
 and moral reasoning, 148–151, 154, 159, 160–161
 and plasticity, 96, 97
 relation to resource-directed behavior, 33–34, 42, 43, 45, 70
 and sociobiological theory, 3, 11, 13, 15, 17, 145–146, 297, 301

Cross-cultural research, 228
 and attractiveness, 221–222
 and child abuse, 294–296, 302–306
 and color categorization, 248–253
 and familial affective relationships, 304, 323–332
 and incest avoidance, 246–248
 and maturation, 210, 211, 219, 220
 and moral development, 143, 157–159, 162
 and puberty rites, 212, 326
 and reproductive strategy, 97, 302, 247–362, 373–393
 and same-sex bonding, 215
 and sociobiology, 12, 14, 17–18
 Culture, 5, 13, 18, 50, 57, 227, 289
 change in, 8, 275, 282, 331
 and genetic evolution, 234–261, 306
see also Cross-cultural research
 Culturegen, 13, 260–261

D

Deception, 104–106, 140
 and cognitive-developmental theory, 15
 and moral reasoning, 156–157
 and self-deception, 106–108, 120, 132
 as strategy of resource acquisition, 27, 39, 47, 50, 54, 66
see also Self-deception
 Developmental tasks, 55–58
 Differential parental solicitude, 272–278; *see also* Child abuse
 Differential survival, 24; *see also* Fitness
 Discriminative parenting, 18, 272–278, 294–295, 298

Divorce, 8, 333–336, 377; *see also* Father absence
 Dominance relations, 11, 20, 146, 213, 214, 235
 and courtship, 224–225
 and maturation rate, 218–220
 and resource acquisition, 25, 37, 46–47, 67
 Drives, 35–38, 42

E

Early experience, 86–88, 92–96, 358–362; *see also* Plasticity, sensitive period
 Ecology, 52–53, 67, 70, 78, 79, 85, 96
 Economics, 25, 32, 33, 38, 70, 222, 245, 325–326, 328, 332, 334, 335, 381
 Egalitarianism, 10, 17, 25, 161, 327, 329
 Egoism, 45–46; *see also* Self-interest, Selfishness
 Emotion, *see* Affect
 Environment
 and adaptation, 6, 20
 and developmental tasks, 57
 and flexibility of behavior, 29
 and natural selection, 25, 271–272
 and resources, 25, 36
see also Environment of evolutionary adaptiveness, Environmental influences, Evolutionarily expected environment
 Environment–expectant genetic system, 10, 89, 323, 330
 Environment of evolutionary adaptiveness, 12, 93, 323; *see also* Environmental influences, Evolutionarily expected environment
 Environmental influences, 69, 78–99, 178, 393
 and behavioral genetics, 16
 and cross-cultural research, 18
 and epigenesis, 83
 and ethology, 12
 and evolutionary theory, 70, 297
 on maturation, 208, 217, 218
 pathological, 9

- Environmental influences (*cont.*)
 and psychology, 4
 and reductionism, 10
 and resource acquisition, 26
see also Environmental variation,
 Environment of evolutionary
 adaptiveness, Evolutionarily
 expected environment, Learning
- Environmental variation
 and cross-cultural research, 18
 and ethology, 11–12
 and heritability, 16
 history of, 3–5
 and psychology, 4–5
 and reductionism, 10
 role of genes in, 4–5
 and social learning theory, 12–14
- Epigenesis, 142, 240, 321, 330
 and natural selection, 82–83
see also Epigenetic rules
- Epigenetic rules, 5, 18, 234–261, 288,
 321–322, 341–342
 and behavioral genetics, 16, 242
 defined, 240–241
 and ethology, 11–12
 heritability of, 19
 and reductionism, 10
 and social learning theory, 13–14,
 19
- Ethology, 5, 6, 9, 11, 185, 218,
 321–322
 and sociobiology, 11–12, 234
- Evolutionarily expected environ-
 ment, 9, 12, 15, 344; *see also*
 Environmental influences,
 Environment of evolutionary
 adaptiveness
- Excuses, 15, 156
- F**
- Father absence
 and development of reproductive
 strategies, 287, 347–362,
 373–393
see also Divorce
- Fitness, 3, 7, 8, 145, 174, 247, 301
 and beliefs, 103, 132
 and contextual variables, 321, 325
 and culture, 244–245
 and environment, 88, 93, 94
 and evolutionary theory, 26, 297,
 340, 347
 and life history theory, 81
 and maturation, 220
 and parenting, 275, 282, 286
 and phenotype, 80
 and plasticity, 90–91, 94
 and play, 84, 85
 and reproductive strategy, 344,
 348, 362, 365, 367–368
 and resources, 65, 300
 and self-deception, 104
 and self-knowledge, 103–104
see also Adaptation, Inclusive fit-
 ness, Natural selection,
 Reproductive success, Repro-
 ductive value
- Friendship
 and genetic relatedness, 182–185,
 193–194
 and reciprocity, 5, 33
see also Peer relations
- G**
- Gene-culture coevolution, 12,
 234–261
- Genetic determinism, 4, 10, 37, 235,
 236, 256; *see also* Indeterminacy,
 Genetic rigidity
- Genetic fixity
 and needs, 35–36
see also Genetic rigidity
- Genetic imperatives, 26–32, 35, 37,
 40, 58
- Genetic influences, 15, 16
 on aggression, 16, 177
 and altruism, 16, 177–182
 and competition, 177–182
 on cooperation, 177–182
 and social interactions, 182–185
 twin methodology, 170–172
- Genetic relatedness, 3, 4, 168, 324
 and bereavement, 185–189
 as contextual variable, 15, 146

- as contextual variable in moral reasoning, 17, 159
- and kinship theory, 43, 174, 175
- and parenting, 272–276, 281–283, 312, 335
- and social interaction, 177–185, 189–193
- as variable in sociobiological analysis, 12, 16, 18, 43, 296
- see also* Coefficient of genetic relatedness
- Genetic rigidity, 29, 286; *see also* Genetic determinism
- Genetic similarity theory, 192, 277–281
- Genetic variation, 5, 7–8, 10, 15, 16, 17, 18, 26, 28, 327, 363; *see also* Heritability, Behavioral genetics
- Genotype
 - and genetic imperatives, 28
 - and development of phenotype, 58, 69, 78–99
- Goals
 - and dominance, 46–47
 - and resources, 33, 34, 35, 38–40, 42
- Group selection, 3, 141, 304
- Growth spurt, 19, 207, 208–212; *see also* Maturation
- H**
 - Helping, 47, 149–150, 159; *see also* Cooperation, Sharing
 - Heritability, 16, 19, 220, 223, 227, 368; *see also* Genetic variation
- I**
 - Imitation, 49; *see also* Modeling
 - Inclusive fitness, 4, 78, 103, 288, 296, 328
 - and parenting, 210, 211, 275–276, 277, 282, 284, 285–286, 305, 306, 307, 311, 313, 314
 - see also* Fitness, Kin selection
- Indeterminacy
 - and adaptation, 25
 - of phenotype, 78, 83, 88
 - see also* Genetic determinism
- Individual differences, 185, 324
 - and altruism, 145
 - and behavioral genetics, 16
 - and canalization, 93, 241–242
 - and cognitive-developmental theory, 14–15
 - and developmental tasks, 57
 - and resource-directed behavior, 68
 - theories of, 5
- Information processing
 - and self-deception, 117
- Innate, 40–41, 245, 253, 254, 256; *see also* Genetic determinism
- Instinct, 29, 49, 235, 286
- Interaction
 - and adaptation, 65, 71
 - gene-environment, 70, 227
 - individual/environment, 26, 37, 39, 57, 58, 70, 71, 93, 235
 - mother-infant, 93
- Intrinsic motivation, 14, 35, 322
- K**
 - Kinship, 33, 177, 192, 211, 215, 282, 294, 295, 323, 325–326, 327, 328–329, 332, 333, 358
 - and altruism, 141, 159, 196
 - theory, 3–4, 174–175, 296
 - see also* Kin selection
 - Kin recognition, 191–192, 277–281; *see also* Genetic similarity theory
 - Kin selection, 43, 141; *see also* Kinship
 - K-selection; *see* Natural selection
- L**
 - Learning, 29, 37, 55, 57, 82, 96, 97, 104, 162, 211, 212, 243, 256, 289, 299
 - and aggression, 40, 49
 - biases, 13–14, 332, 343–347
 - and instinct, 29, 40–41
 - and life history strategy, 80
 - and maturation, 208–209

Learning (*cont.*)

- and reproductive strategy, 340, 341–362, 373, 380–381, 393
- and resource acquisition, 33, 47, 53
- rules of, 297–298
- see also* Epigenetic rules

Life history, 96

- and adaptation, 25–26
- and canalization, 89–90, 92
- and plasticity, 89–90
- theory of, 78–88

M

Maladaptive behavior

- and achievement of ideals, 32
- and altruism, 141, 151
- and beliefs, 124, 126
- and canalization, 95–96
- and child abuse, 305–306, 312–313
- and family relationships, 323, 330
- and psychiatric disorders, 7–8, 362–363
- reasons for, 7–10, 298
- and self-knowledge, 105

Manipulation, 66, 113, 115, 124, 132

- of other's affect, 15
- of own affect, 112
- by parents, 286–287
- and resource competition, 27, 39, 47, 50, 67, 342, 359, 360, 364–366
- socialization of, 54–55

Maturation

- and attractiveness, 220–223
- control of, 217–218
- and developmental tasks, 55, 57
- and dominance, 218–220
- of humans, 210–212
- and needs, 37
- and parent-offspring conflict, 213
- of primates, 208–210
- versus early experience, 92–93

Memory, 237–240, 243

Modeling, 13, 46, 144–145, 162; *see also* ImitationMoral development, 11, 142; *see also*

Moral reasoning

Moral reasoning, 18, 20, 123, 142–163

- and context, 17, 125–126
- see also* Moral development

N

Natural selection, 3, 122, 221, 235, 288, 321, 329, 333, 340, 343

- and adaptation, 6–7, 8, 79, 296
- and beliefs, 105, 132
- and canalization, 94
- and choosing environments, 58
- and cultural change, 18, 275
- and environments, 25, 271–272
- and genetic determinism, 10
- and kinship theory, 174
- K-selection, 52, 81, 82, 84, 90, 96, 98, 210, 299–300, 307, 356
- and maturation, 217
- and phenotype, 70
- and plasticity, 86–88
- r-selection, 52, 81, 98, 299
- and resources, 35
- and sex differences, 301, 324
- see also* Fitness, Adaptation

Nurturance, 226–227, 299, 304, 359, 375; *see also* Parent-child interaction, Parent-offspring conflict**P**

Parental investment, 98

- and family interactions, 282–286, 287, 297, 299–302, 305, 311
- and life history theory, 80, 84
- and reproductive strategy, 212, 222, 321, 324, 325, 329–330, 334, 335, 348–350, 357–359, 373, 379–381
- and resource theory, 53, 56

Parent-child interactions, 227, 235

- and child abuse, 309–311
- and ethology, 11
- and resources, 24–25, 63–64, 272–276
- and socialization, 321–332, 367
- see also* Discriminative parenting, Nurturance, Socialization

Parent-offspring conflict, 3, 213–214, 294, 320; *see also* Conflict of interest

- Peer relations, 18, 208, 288
 and ethology, 11–12
 genetic influences, 183
 and maturation, 218, 219, 221, 222
 and resource-directed behavior, 64, 359–362
 and socialization, 53, 54, 332, 352, 359–362
see also Friendship
- Perception, 12, 227, 243, 300, 358
 and epigenetic rules, 245, 248–253
 and language acquisition, 253–254
 and musical understanding, 254–256
 and resource acquisition, 38, 60
 and self-deception, 117
- Personality
 and adaptation, 8, 42
 and child abuse, 309
 and gene-culture coevolution, 237
 and resource acquisition, 60
 and self-deception, 115, 119–120
- Phenotype, 19, 240, 327, 330, 332
 and genetic imperatives, 28, 58
 and genetic variation, 4, 8, 16
 matching, 175, 277–281, 285
 and natural selection, 70
 as unit of sociobiological analysis, 4, 10, 11, 12, 69, 78–99
- Plasticity, 28, 29, 87, 96–99
 and adaptation, 9, 208–209, 286, 303, 348
 and canalization, 89–92
 and life history, 84–85
 and malnourishment, 303
 as object of selection, 88
 and reproductive strategy, 348, 375
- Play, 235
 genetic influences, 183–185
 and life history theory, 83–85
 and resources, 209
- Primary reinforcement, *see* Reinforcement
- Prosocial behavior, 331–332
 and cooperation, 45
 and egoism, 46
see also Altruism
- Proximate mechanisms, 140, 289, 296, 297, 336
 and adaptationism, 6
 and child abuse, 293, 294, 302–311, 312, 313–314
 defined, 4
 and family relationships, 320, 321
 and kin recognition, 278–281
 and reproductive strategy, 347–362, 379–393
 and resource-directed behavior, 35, 39, 42
 and sociobiology, 18–19, 234–235
 and self-deception, 120–122
 and social exchange theory, 34
- Puberty, 207, 218, 227
 and attractiveness, 222–223
 and dominance, 218–220
 and growth spurt, 208–212
 and parent-offspring conflict, 213–214
 rites of, 208, 212, 215, 216, 305, 326, 378
see also Adolescence
- R**
- r-selection, *see* Natural selection
- Rationalization, 20
 and moral reasoning, 143, 149, 151, 153, 155, 156
- Reciprocity
 and altruism, 43, 141, 196
 in children's friendships, 5, 161, 196
 and moral reasoning, 143
 and resource acquisition, 40, 342, 364
 and resource exchange, 25, 33, 36, 364
- Reductionism, 10, 11, 17, 234, 321
- Reinforcement, 13, 33, 37, 42, 49, 129, 309, 310, 322
 and altruism, 143–144, 161
see also Learning, Rewards
- Reproduction, 4, 235, 340
 as developmental task, 53–54
 and ecology, 70
 as genetic imperative, 28, 29, 34, 56
 and individual/environment interaction, 26
 and resources, 24, 25, 40

- Reproduction (*cont.*)
 and social controls, 327
see also Fitness, Reproductive strategies, Reproductive success, Reproductive value
- Reproductive potential, *see* Reproductive value
- Reproductive strategies
 and child abuse, 296–297, 300, 305, 311
 development of, 286–287, 340–368, 373–393
 and family relationships, 324–325, 329, 333
 and life history theory, 80–81
 and plasticity, 96–98
see also Reproduction
- Reproductive success, 8, 71, 324
 and adaptation, 298
 and altruism, 43, 342
 and canalization, 94, 95
 and cost/benefit ratios, 70
 and discriminative parenting, 211, 273, 274–275
 and incest avoidance, 247–248
 and learning, 342–345
 and maturation, 217, 218
 and plasticity, 96
 and reproductive strategies, 305, 314
 and resources, 24–26, 33, 34, 35, 65, 68, 333
 and socialization, 53
 and sociobiological theory, 296
see also Fitness, Natural selection, Reproduction, Reproductive value
- Reproductive value, 19, 24, 43, 44, 82, 334
 and parenting, 212, 273–274, 276–278, 285
see also Reproduction, Reproductive success
- Resource competition, 24–25, 27, 28, 32, 40–41, 44–50, 53–55, 69, 209, 220, 222, 295, 303, 312, 324, 356, 364–366; *see also* Competition, Resources
- Resource(s), 7, 9, 12, 13, 20, 24–72, 333
- acquisition, 24, 25, 40, 60, 65, 312, 343, 379
 and child maltreatment, 306–308, 309, 313
 definition, 32–35
 dimensions of, 35–36
 -directed behavior, 38–40, 59–60, 63–69, 71
 and dominance, 46–47, 220
 and life history theory, 80, 81, 82
 and parenting, 222, 273, 274, 282, 285–286, 295, 297, 299–302, 306–308
 and plasticity, 91, 97, 98
 and play, 209
 and reproductive strategy, 324–325, 329–330, 344–345, 347–351, 356–362, 367–368, 379–381
 sex differences, 325
see also Resource competition
- Rewards
 and child abuse, 309–310
 and continuity, 96
 and family affective relationships, 322–323
 and learning biases, 343
 and resource acquisition, 33–35, 42
 and social learning theory, 13–14
- Risk, 50, 65, 216, 225, 301, 314, 346
- S**
- Self-deception, 103–133, 225
 and cognitive-developmental theory, 15
 defined, 106–108
 and moral reasoning, 143, 147, 153–154, 155–156
 proximate mechanisms, 118–120
 research on, 108–118
see also Deception
- Self-esteem, 119, 127–128
- Self-interest, 4, 13, 18, 19, 20, 33, 44, 119, 321, 326
 and moral reasoning, 140–148, 151–159, 161, 162
see also Selfishness
- Self-knowledge, 103–133
 and adaptation, 120–124

- Selfishness, 19, 182
 as central tendency of human behavior, 5, 10, 15, 20
 and moral reasoning, 143, 152–153, 155, 161
 as strategy of resource acquisition, 43–44, 45
see also Self-interest
- Self-sacrifice, 13, 44, 140, 154
- Sensitive period, 80, 85, 86, 97, 373, 380–381; *see also* Early experience, Plasticity
- Sex differences, 5, 66, 212, 347, 364
 in courtship behavior, 224–225
 and father absence, 352–356, 376–393
 in maturation, 209–210, 217–218, 223
 in moral reasoning, 152, 155
 in parental investment, 284, 285
 in reproductive strategy, 324–325, 333
- Sexual behavior, 19, 96, 245, 247
 courtship, 224–225
 and father absence, 349–350, 352, 354–355, 361, 373
 and maturation, 211, 221, 222, 287
- Sexual competition, 7, 12, 18, 161, 208, 300, 301, 324, 325, 326, 327, 328, 329, 332, 351, 379–380; *see also* Competition, Resource competition
- Sharing, 47, 144–145; *see also* Cooperation, Helping
- Siblings, 54, 63, 188, 189
 incest avoidance, 246–248
see also Twin research
- Social cognition, 18, 116, 121
- Social controls, 8–9, 10, 17, 161, 162, 326–327, 333, 334, 335, 336
- Social exchange theory, 33–34, 42
- Socialization, 9, 12, 240
 of altruism, 145, 161–163, 346
 in family, 320–336
 of girls' maturation, 222–223
 of incest avoidance, 247–248
 and plasticity, 85–86
 of reproductive strategy, 341–362, 373–393
 of resource-related behavior, 42, 53–55, 58
 of sex-roles, 381–383
- Social learning, 5, 12–14, 145, 161, 332, 336, 346, 347
- Social status, 7–8, 43, 60, 63, 245, 293, 305, 312, 314, 330, 332, 333–335, 360, 363–364, 376–377, 385
- Social structure, 25, 42; *see also* Social controls, Social status
- Sociobiology
 and adaptationism, 5–10
 and behavioral genetics, 16, 169, 172, 177
 and bereavement, 185–189
 and deception, 106–108
 and developmental psychology, 3–20, 78, 236–240
 and ethology, 11, 234
 history of, 3–4
 and learning, 342–345
 and moral reasoning, 140–142, 158–159
 and parenting, 271–289
 and phenotype, 4–5, 78–88
 and proximate mechanisms, 18–19
 and resources and resource acquisition, 24–28, 42–46
 and self-knowledge, 103–104, 106–108
 and socialization, 320–336
- T**
- Twin research, 16, 168–199
- U**
- Ultimate causes, 4, 6, 120, 140, 235, 236, 293, 296, 312, 324, 352
- Universals, 12, 14–15, 17, 241–242, 246, 254, 256, 344–345; *see also* Buffering of phenotype, Canalization, Central tendencies